# FIELD ARTILLERY TRAINER

with Ammunition Cal. 14.5 mm

- Description and Operation Instructions -

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FIGURE 1 TRAINER, FIELD ARTILLERY: CAL. 14.5 MM
ABBILD. 1 AUSBILDUNGS-SCHIESSGERÄT 14,5 MM

# CONTENTS

# Preliminary Note

The field artillery trainer cal. 14.5 mm is an allround training device for artillerymen, not only suited for individual training of artillerymen as observers, gun layers etc. but also for fostering training of all artillerymen within a unit even up to an artillery group.

For suggestions and hints concerning the practical use of the artillery trainer during training please consult the leaflet:

FIELD ARTILLERY TRAINER
with ammunition cal. 14.5 mm
— Suggestions for its Use —

The present leaflet explains the technical construction of the artillery trainer and of the ammunition cal. 14.5 mm, handling of the artillery trainer by the operating crew and its maintenance, care and repair.

# Part I
# Description of the Device Elements

## 1. Main Elements

The artillery trainer consists of the following main elements:
- the tripod
- the mount
- barrel with breech and
- the laying gears.

## 2. The Tripod

The tripod consists of:
3 tripod legs
1 tripod base.

### 2.1. The Tripod Legs

The strong tubular steel tripod legs are coupled to the tripod base and can be swung out. With their fork-shaped upper end they are pushed over the shackles of the tripod base and fixed to the base by means of a bolt. They can be wedged by means of locking levers (fig. 2–5) fixed to the bolts, so that they remain in the desired position.

At their lower end the tripod legs are provided with spurs (fig. 2–6) in order to ensure a firmer stability in the ground. There is a tripod adjusting sleeve on each tripod leg (fig. 2–7). They are used to level the artillery trainer. The mid-position of the adjusting sleeve is marked by a yellow ring groove, the limit positions by red ring grooves. One of the tripod legs has an extendible rear leg (fig. 2–8) which, on loosening the lower locking lever (fig. 2–9) allows for extension of the leg by 38 cm. In that way the uneveness of the ground can be levelled.

### 2.2. The Tripod Base

The tripod base serves for fastening the tripod legs and for receiving the mount. The tripod base is fitted with three shackles (fig. 2–4) for fixing the tripod legs. On its upper surface it has a raised concentric steel band (fig. 2–1) which allows for rapid centering of the mount and prevents lateral slipping. The mount is fixed to the tripod base by means of a fitting key (fig. 2–2). The mount is secured to the tripod base by tightening the mount locking screw (fig. 2–3).

## 3. The Mount (figs. 3, 4 and 5)

The mount consists of:
- the base mount and
- the upper rotating mount.

### 3.1. The Base Mount

On its bottom the base mount (fig. 3–1) has the corresponding recesses for receiving the tripod base and the thread for the locking screw. Inside the worm wheel gear of the traversing mechanism is screwed together with the base mount and in addition the pintle pin for taking up the rotating bearing of the upper mount is flanged to it. This pintle pin has a ring groove at its upper end in which the spring-loaded mount locking plunger (fig. 3–3) rests. Thus an axial connection of the upper mount with the base mount is assured.

### 3.2. The Upper Rotating Mount

The upper rotating mount (fig. 3–2) consists of two cheeks with hinged trunnion seats (fig. 3–4). To the left cheek the bracket (fig. 3–5) for the socket (fig. 3–6) of the panoramic telescope is screwed. At the base of the right-hand cheek there are two level vials (fig. 3–7) located at 90° angle to facilitate levelling of the artillery trainer. Between the cheeks the elevating mechanism is placed (fig. 3–8). In the base of the upper rotating mount the traversing mechanism is located (fig. 3–13 and 4–15).

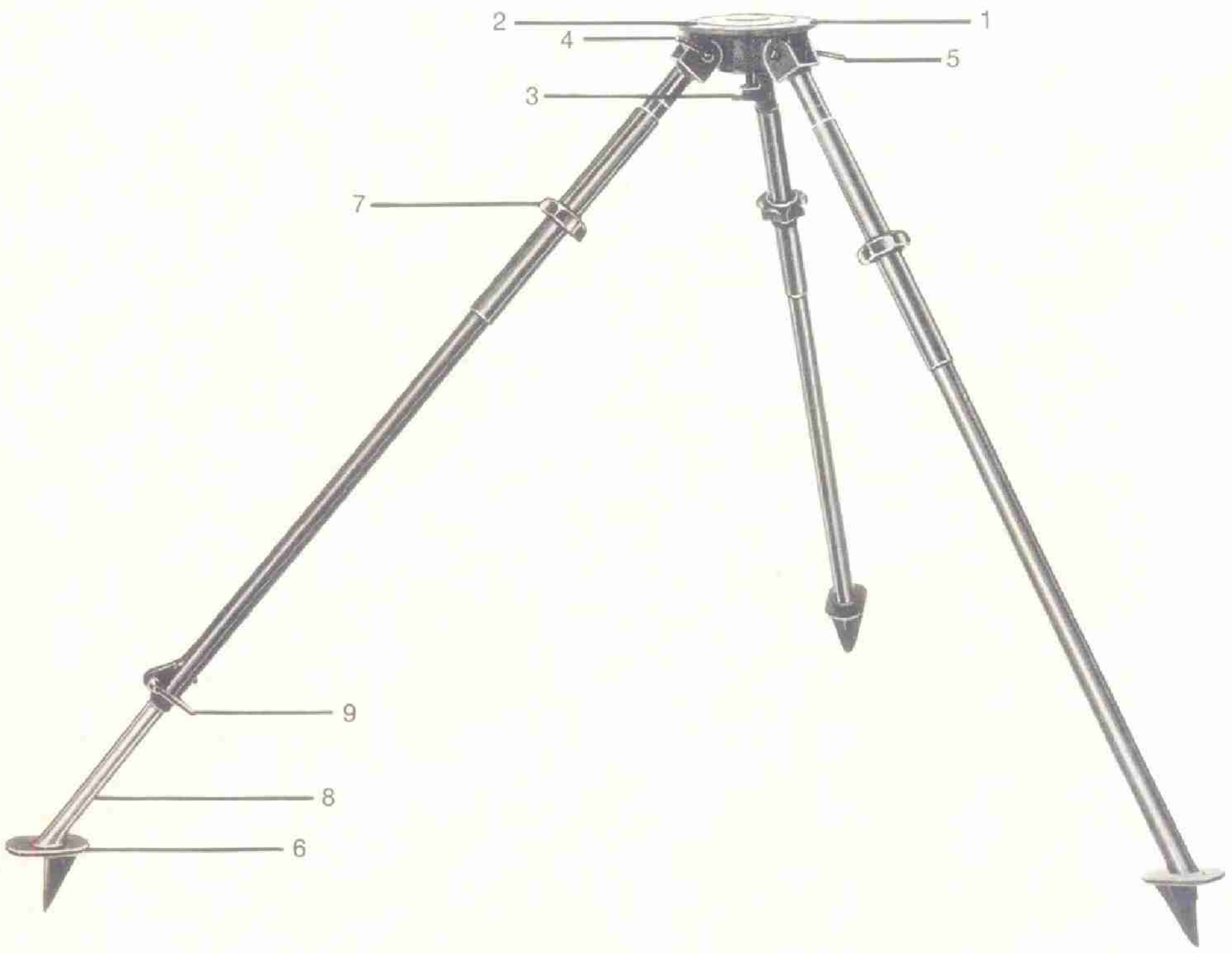



FIGURE 2 TRIPOD GROUP

ABBILD. 2 DREIBEIN-STATIV MIT PLATTE

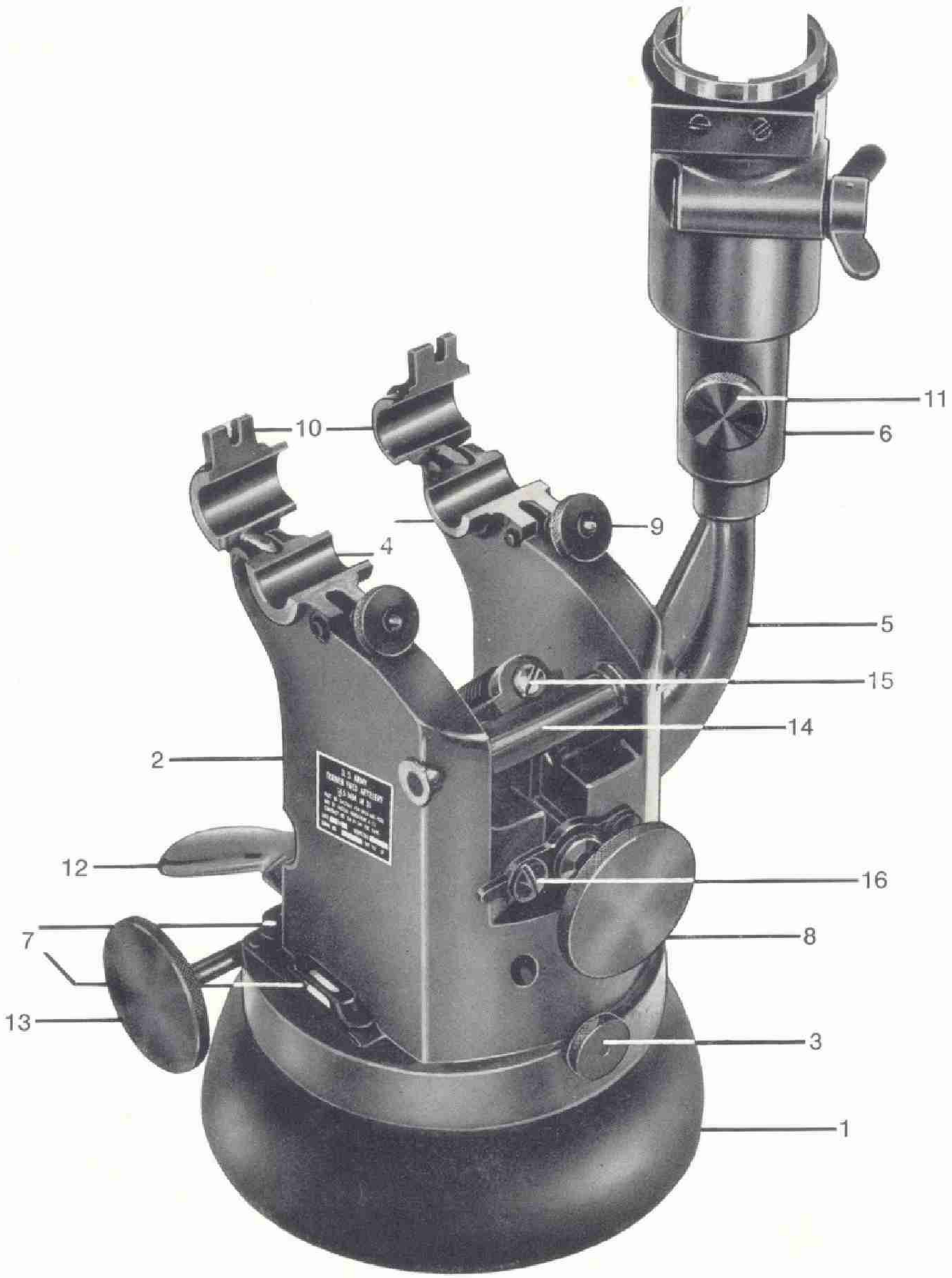



FIGURE 3 MOUNT GROUP
ABBILD. 3 LAFETTE MIT AMERIK. AUFNAHMEHÜLSE

3.2.1. **The trunnion seats** (fig. 3—4) serve for bearing the barrel with breech. In order to insert or remove the barrel with breech the tiltable lock knobs (fig. 3—9) must be unscrewed and the trunnion caps (fig. 3—10) have to be opened.

3.2.2. The **socket** (fig. 3—6) is mounted on the **bracket** (fig. 3—5). The socket is secured by a fitting key inserted into the bracket and by tightening of the locking screw (fig. 3—11).

The socket must correspond to the panoramic telescope used. This has to be particularly watched as the artillery trainer is supplied without panoramic telescope. The corresponding brackets for the different panoramic telescopes of the combat guns are available or can be manufactured on request.

3.2.3. The **traversing mechanism** is incorporated in the base of the upper mount. The traversing worm is located inside the spring-loaded worm-gear housing which is swivel-mounted. The traversing worm meshes with the worm wheel gear inside the base mount. By turning the traversing handwheel (fig. 3—13) the upper mount is turned on the base mount. By pressing downward on the rapid traverse lever (fig. 3—12 and 4—15) the traversing worm is disengaged from the worm wheel so that the upper mount can be rotated on the base mount through 360 deg. thereby allowing a rapid traverse change. If the pressure on the level is released the worm automatically re-engages into the worm wheel gear due to spring pressure.

Any backlash inside the worm bearing is eliminated by tightening the setscrew (fig. 4—1).

3.2.4. The **elevating mechanism** consists of a spring-loaded worm gear bracket (fig. 3—14) for the elevating worm gear and its shaft as well as of an elevating gear sector (fig. 5—13) tightly screwed to the barrel and the receiver which meshes with the elevating worm gear when the barrel is inserted. The elevating worm gear can be made free of backlash by means of the adjusting screw (fig. 3—15) on the front face of the worm gear bracket. The elevating worm gear is driven by the elevating handwheel (fig. 3—8) which via a drive shaft and a pair of bevel gears is pressure connected to the worm gear. Any backlash of the bevel gears can be eleminated by tightening the adjusting screw fixed to the drive shaft exit. Between the cheeks of the upper mount there is a swivel rapid elevating locking plate (fig. 3—16) to avoid disengagement of the worm gear from the elevating gear sector during operation of the worm drive. By lifting the rapid elevating locking plate and pulling the elevating handwheel the elevating worm gear can be disengaged from the elevating gear sector at the barrel, thereby allowing a rapid change of elevation from 0° to + 90° (0⁻ to 1600⁻). When the pressure is released the elevating worm gear automatically re-engages in the elevating gear sector. The locking plate has to be closed again.

## 4. **The Barrel with Breech** (figs. 4 and 5)

### 4.1. **Barrel Description**

The barrel has a calibre of 14.5 mm, 8 grooves with a uniform right hand twist and a chamber with a length of 54 mm.

On the upper surface of the barrel there are a sight notch (fig. 4—4) and a bead sight (fig. 4—5) for direct laying. The top portion of the barrel has a flat machined surface (fig. 4—6) for taking up a quadrant. The elevating gear sector (fig. 5—13) belonging to the elevating mechanism is screwed to the lower surface of the barrel.

### 4.2. **Description of the Breech**

The main parts of the breech are
- the receiver
- the bolt assembly.

#### 4.2.1. **The Receiver**

The receiver is connected to the barrel by a thread. A bracket with the two trunnions is placed on the front part of the receiver. The right trunnion is designed as a square outside the trunnion seat and has an axial threaded hole. Onto this square the elevating laying gear is pushed (fig. 4—3) and tightly screwed with the knurled knob (fig. 4—12) which is rotatably fastened with the threaded spindle in the clamping nut. A part of the elevating gear sector belonging to the elevating mechanism is screwed at the bottom of the receiver.

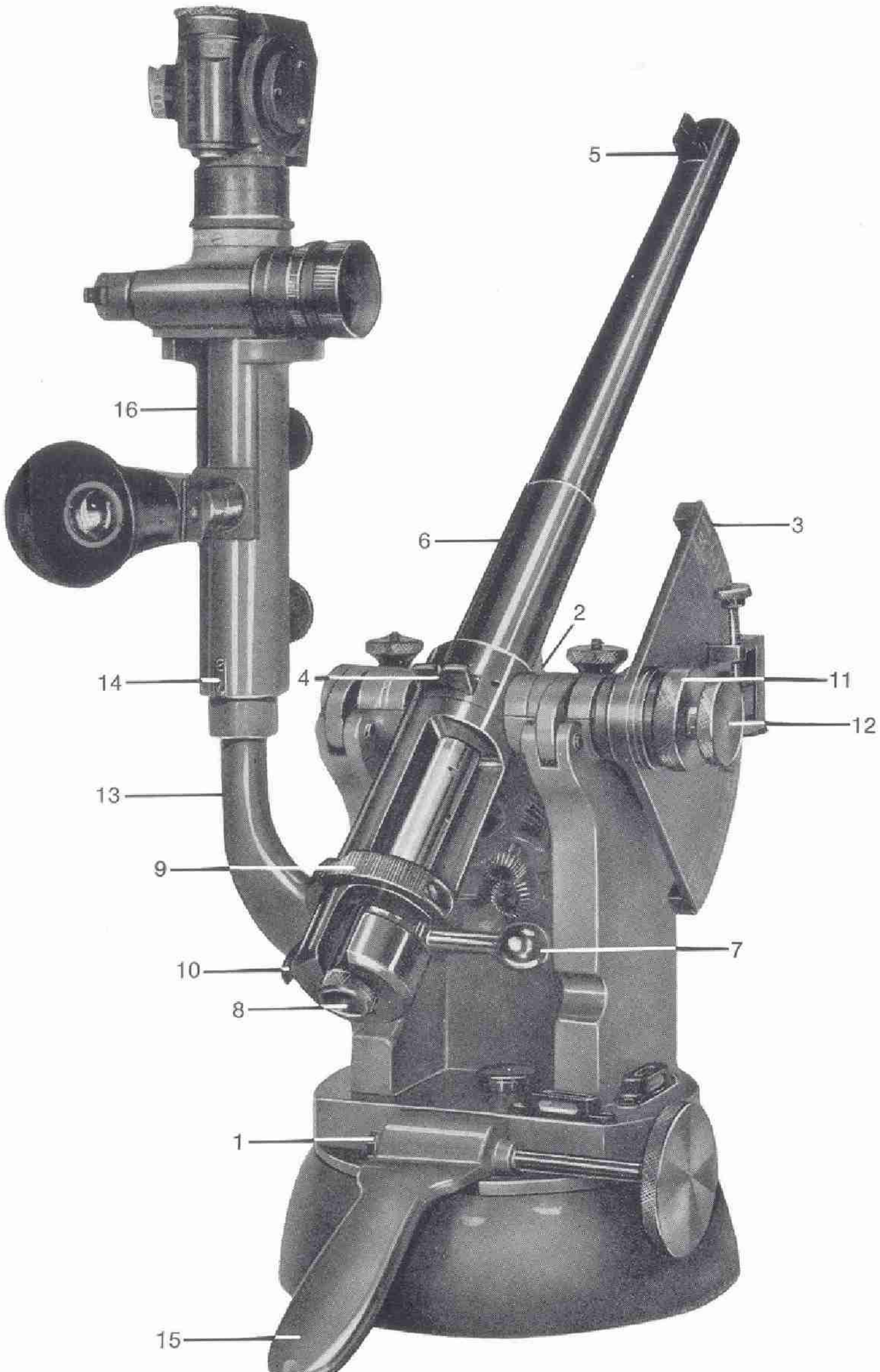



FIGURE 4 MOUNT GROUP WITH BARREL

ABBILD. 4 LAFETTE MIT ROHR UND RUNDBL.-FERNROHR

The trigger mechanism consists of a single spring-loaded lever with a sear (guide bolt) which is mounted on the left hand side and to the rear of the receiver (fig. 4—10). The rotatable safety ring (fig. 4—9) fits round the receiver. The safety ring is fixed by two lateral safety stop screws and by the bolt lock (fig. 5—11) which is located on the bottom of the receiver. For placing at "safe" the safety ring is turned to the left until it is stopped by the safety stop screws. In this position the trigger is blocked. The marking of the safety ring points to the white letter "S" of the receiver. If the safety ring is turned to the right so that its marking points to the red letter "F", the trigger can be pulled for firing.

### 4.2.2. **The Bolt Assembly**

The bolt consists of breech bolt, breech bolt lever (fig. 4—7), firing pin, firing pin spring, detent spacer, breech bolt screw, firing pin spring guide (fig. 4—8) and extractor.

The bolt lock limits the backwards movement of the bolt in the receiver. The bolt can be completely withdrawn from the receiver and even inserted into the receiver by pulling the spring-loaded bolt lock at the bottom of the receiver.

The bolt has to be withdrawn from the receiver in order to disassemble it. After that the breech bolt screw has to be turned counterclockwise. Then the firing pin, firing pin spring and guide can be removed from the bolt.

## 4.3. **Technical Data and Informations**

| | | |
|---|---|---|
| Barrel calibre | 14.5 | mm |
| length of chamber | 54 | mm |
| field diameter in the barrel | 14.23 | mm + 0.04 |
| groove diameter in the barrel | 14.63 | mm + 0.05 |
| number of grooves | 8 | |
| width of grooves | 4 | mm |
| length of barrel | 400 | mm |
| length of barrel, rifled section | 334 | mm = 23 cal. lengths |
| uniform right-hand twist, one turn in | 8.5° | |
| length of twist | 300 | mm = 20.7 cal. lengths |
| elevation limits | from | 0° to + 90°<br>0⁻ to + 1600⁻ |
| traverse | 360° = 6400⁻ | |
| height of muzzle above ground | 1.30 m | |

The barrel and breech, whilst undergoing quality tests, are tested for solidity and accuracy of fire.

# 5. **The Laying Gears**

There are two laying gears:
- the elevating laying gear and
- the traversing laying gear.

## 5.1. **The Elevating Laying Gear**

The elevating laying gear consists of:
- the elevation scale,
- the setting slide,
- the level vial slide.

5.1.1. The **Elevation Scale** (fig. 5—1) has the form of a quadrant, it is marked with 1.600 mils.

5.1.2. The **Setting Slide** (fig. 5—2) is moved across the mils marks of the elevation scale by means of a swing-out worm drive with shaft and knurled knob screw (fig. 5—5).

Upon lateral pressure against the knurled knob screw the worm is disengaged from the gear rim of the elevation scale (fig. 5—6) for rough setting of the elevation angle. If the pressure is released the worm automatically re-engages with the gear rim due to spring pressure. Then the setting slide can only be moved by turning the knurled knob screw for precision setting of the barrel elevation angle. With the help of the vernier sliding across the mils marks inside the window the elevation angle can be set with an accuracy of 1⁻.

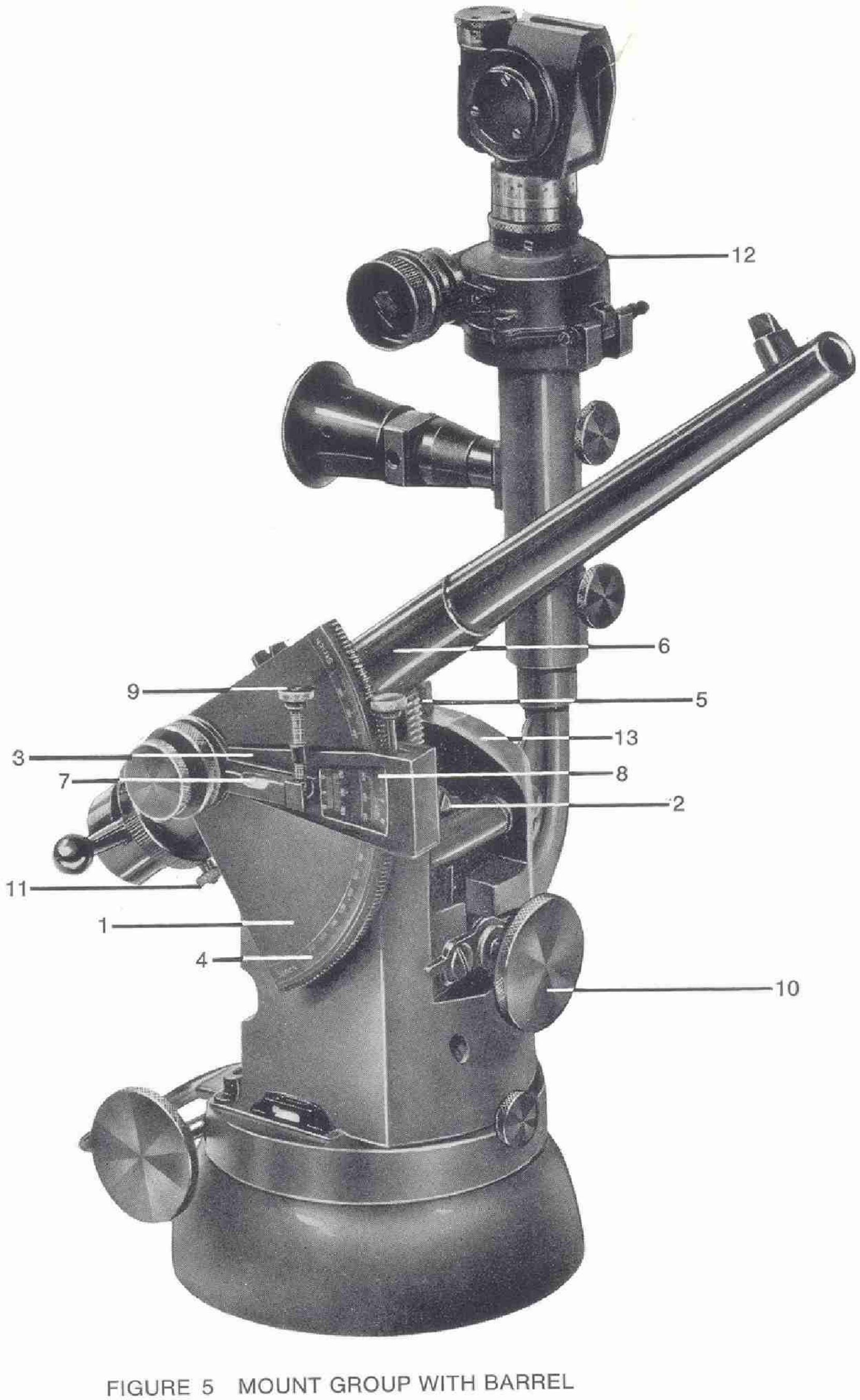



FIGURE 5 MOUNT GROUP WITH BARREL

ABBILD. 5 LAFETTE MIT ROHR UND HÖHENRICHTMITTEL

5.1.3. The **Level Vial Slide** (fig. 5–3) with the level vial (fig. 5–7) has on its bevelled setting plate (fig. 5–8) a vernier running along the level vial graduations visible in the window of the setting slide. By turning the micrometer screw (fig. 5–9) a positive or negative level vial angle can be set with an accuracy of 1⁻. Thus the position of the level vial at the level vial slide is altered with reference to the barrel elevation angle set on the elevation scale. The angle of site to the target can be taken into account with the level vial slide. Calibration data of the barrel are compensated by means of the level vial slide.

The total elevation angle of the barrel is transferred to the axis of the bore of the barrel by using the elevating mechanism until the bubble of the level vial slide reaches equipoise.

5.1.4. The **Quadrant** of the combat gun can be used as elevating laying gear put on the flat machined surface of the barrel (fig. 4–6). In this case the barrel has to be moved by using the elevating mechanism as long as the level vial of the quadrant reaches equipoise.

## 5.2. The Traversing Laying Gear

The panoramic telescope of the combat gun is used as traversing laying gear (fig. 5–12). The panoramic telescope is inserted into the socket on the bracket of the upper mount (see also 3.2.2.) and fastened there with a clamping mechanism. The panoramic telescope is adjusted using the tangent screws on the telescope.

## 6. The Storage Chest

The artillery trainer can be stored and transported in a chest (fig. 6) and for that purpose it can be dismounted into the following parts:

- the tripod
- the mount
- the barrel with breech
- the socket
- the elevating laying gear with leather pouch.

The individual elements of the artillery trainer are held within the chest by special felted brackets and by wooden partitions so that when carried in the closed chest they are easily and safely transported. They are arranged in the chest in the correct order for reassembly.

The chest contains additional as accessories: The necessary cleaning equipment, tools and repair parts.

Together with its contents the chest weighs 82 kgs. It has four folding handles at the two ends of the long sides of the chest.

In case of shipment together with its contents the chest is transported in a special overchest.

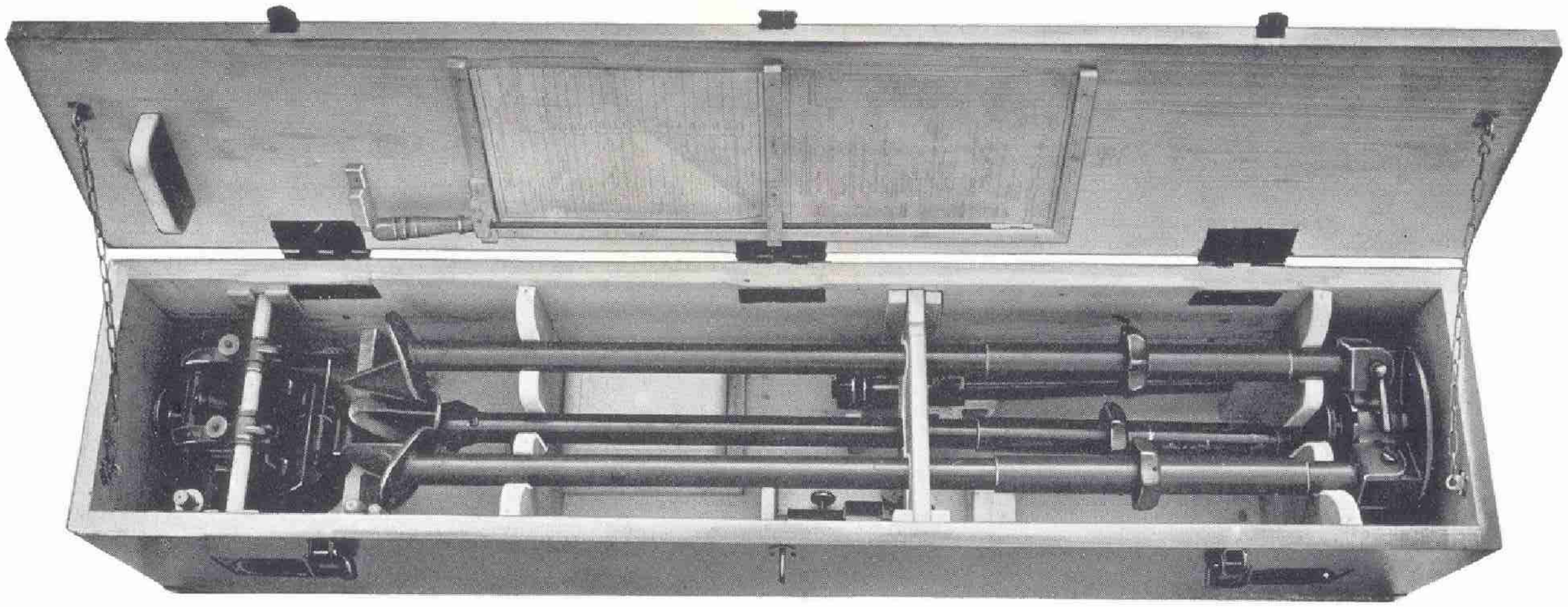


FIGURE 6 STORAGE CHEST
ABBILD. 6 AUFBEWAHRUNGSKASTEN

# Part II
# Description of the Training Ammunition

## 1. Kinds of Ammunition

The training ammunition of the artillery trainer is a cartridge ammunition of cal. 14.5 x 51, the number 51 denominating the length of the cartridge case. According to their construction there are three different types:

- the training cartridge with impact fuze
- the training cartridge with delay fuze
- the maneuver cartridge.

The training cartridges are available with three different propelling charges – first, second and third charge –, and in addition the training cartridges with delay fuze are supplied with two different delays of 3 and 6 seconds.

## 2. Construction of the Training Cartridge

The training cartridge consists of

- the cartridge case (fig. 7–2 and 8–2) and
- the projectile (fig. 7–1 and 8–1).

The cartridge case is made of an aluminium alloy. Its profile and size conforms to that of the chamber of the trainer barrel. The cartridge case is crimped to the projectile as one unit and serves as the container for the propelling charge.

The propelling charge consists of the propellant composition (fig. 7–5 and 8–5) the quantity of which corresponds with the charge (first, second or third charge).

A priming cap with the primer (fig. 7–6 and 8–6) is inserted in the base of the cartridge case.

The projectile is a lead jacket one which is stabilised against twist by five driving bands. The lead jacket (fig. 7–3 and 8–3) incloses an intermediate steel casing (fig. 7–4 and 8–4) as a reinforcement against excessive strain when the projectile is fired.

### 2.1. **Training Cartridge with Impact Fuze** (fig. 7)

#### 2.1.1. **Designation**

Training cartridge cal. 14.5 mm x 51, impact fuze, . . . charge.

#### 2.1.2. **Construction of the Projectile**

Inside the intermediate steel casing of the projectile there are

- the igniter case (fig. 7–13) containing the elements of the impact fuze, and
- the smoke composition case (fig. 7–14) containing the smoke composition (fig. 7–15).

The base of the projectile is covered with a plastic base cap (fig. 7–16).

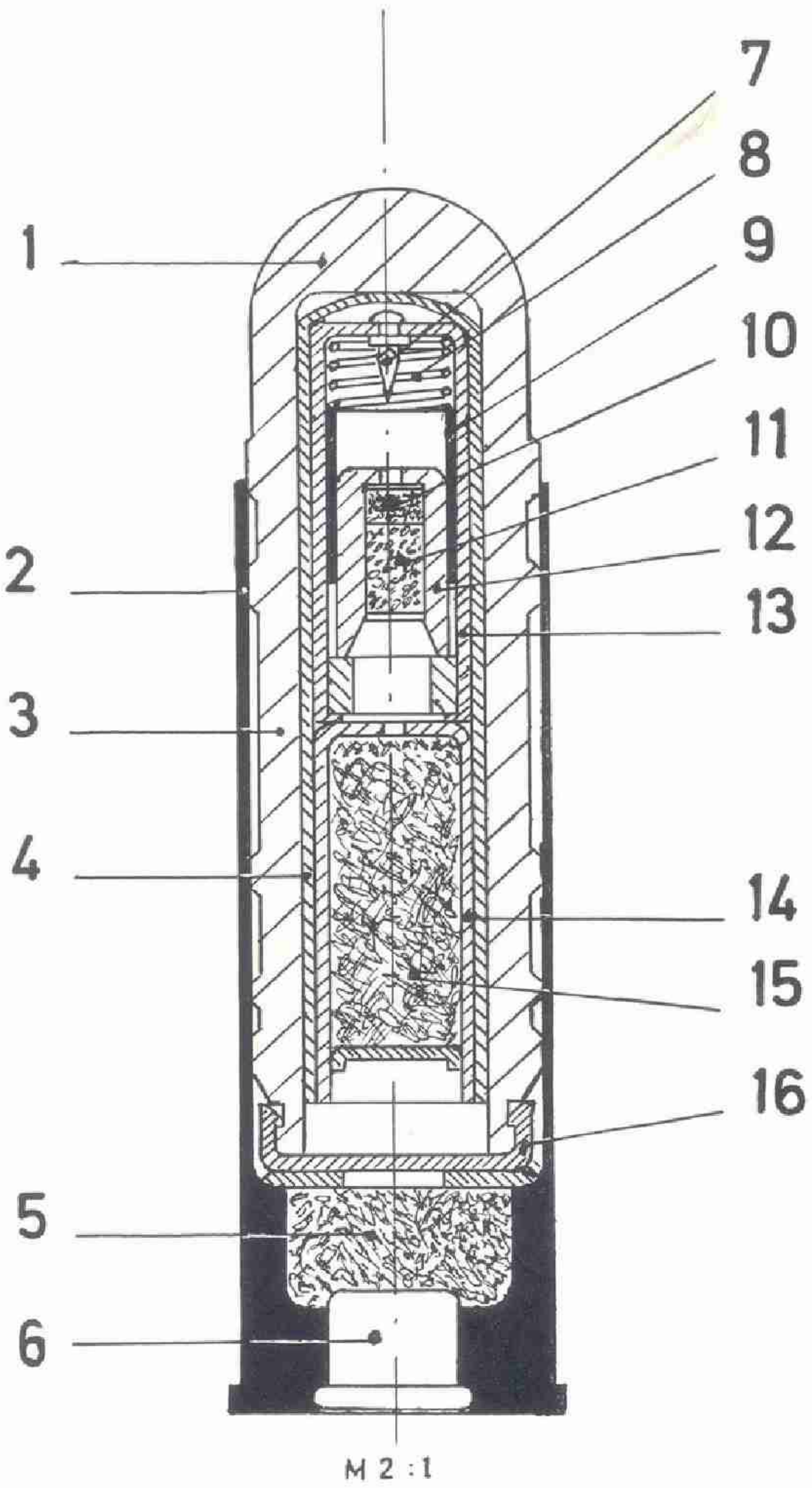
The impact fuze consists of the igniter case (fig. 7–13) with the firing pin (fig. 7–7) rivetted into its head, the safety spring (fig. 7–8) and the firing bolt (fig. 7–12) with safety casing (fig. 7–9), igniter (fig. 7–10), booster (fig. 7–11) and the paper plate. The individual elements are joined together by crimping of the igniter case.

#### 2.1.3. **Functional Description**

When the firing pin strikes the priming cap, the primer ignites the propellant composition. The gas pressure of the propellant composition forces the projectile out of the barrel. Owing to this impulse the safety casing slides backwards on the firing bolt thus arming the igniter. So only the safety spring sits between firing bolt and firing pin.

**Training Ammunition 14.5 mm x 51 with Impact fuze**
**Key for figure 7**

**Übungsmunition 14,5 mm x 51 mit Aufschlagzünder**




| | | | |
|---|---|---|---|
| 1 | projectile | 9 | safety casing |
| 2 | cartridge case | 10 | igniter |
| 3 | lead jacket | 11 | booster |
| 4 | intermediate steel case | 12 | firing bolt |
| 5 | propellant composition | 13 | igniter case |
| 6 | priming cap with primer | 14 | smoke composition case |
| 7 | firing pin | 15 | smoke composition |
| 8 | safety spring | 16 | plastic base cap |

FIGURE 7
ABBILD. 7

When the projectile impacts in the target area the safety spring is pressed together and the firing bolt strikes the firing pin with the igniter. The igniter together with the booster ignites the smoke composition, which is ejected through the back end of the projectile. This entire action results in an audible report, a flash to be seen from afare and a light grey smoke cloud. As the projectile does not contain any explosive charge, there is no fragmentation when the projectile impacts.

## 2.2. **Training Cartridge with Delay Fuze** (fig. 8)

### 2.2.1. **Designation**

Training cartridge cal. 14.5 mm x 51, delay fuze, . . . charge, delay 3 seconds or 6 seconds.

### 2.2.2. **Construction of the Projectile**

Inside the intermediate steel casing of the projectile there are

- the smoke composition (fig. 8–7), filling the intermediate casing at two thirds and
- the delay casing (fig. 8–11), containing the time delay charge (fig. 8–10) and the igniter case (fig. 8–8) which the ignition charge (fig. 8–9) contains.

The base of the projectile is covered with a paper disk and a partial plastic base cap (fig. 8–12).

### 2.2.3. **Functional Description**

When the firing pin strikes the priming cap, the primer ignites the propellant composition which then ignites the time delay charge. The gas pressure of the propellant composition forces the projectile out of the barrel.

After a flying time of 3 or 6 seconds the time delay charge ignites the smoke composition via the ignition charge, which is ejected through the back end of the projectile. This entire action results in an audible report, a flash to be seen from afare and an outlined yellowish-white smoke cloud which marks the "bursting point" of the projectile in its trajectory. As the projectile does not contain any explosive charge, there is no fragmentation by igniting the smoke composition.

## 2.3. **Maneuver Cartridge**

### 2.3.1. **Designation**

Maneuver cartridge cal. 14.5 mm x 51

### 2.3.2. **Construction of the Maneuver Cartridge**

The maneuver cartridge only consists of a cartridge case without a projectile. The cartridge case contains:

- the primer which is inserted in the base of the cartridge case as the priming cap, and
- the report charge, which is dammed by a closure.

### 2.3.3. **Functional Description**

When the firing pin strikes the priming cap, the primer ignites the report charge. This results a report, audible at a long distance.

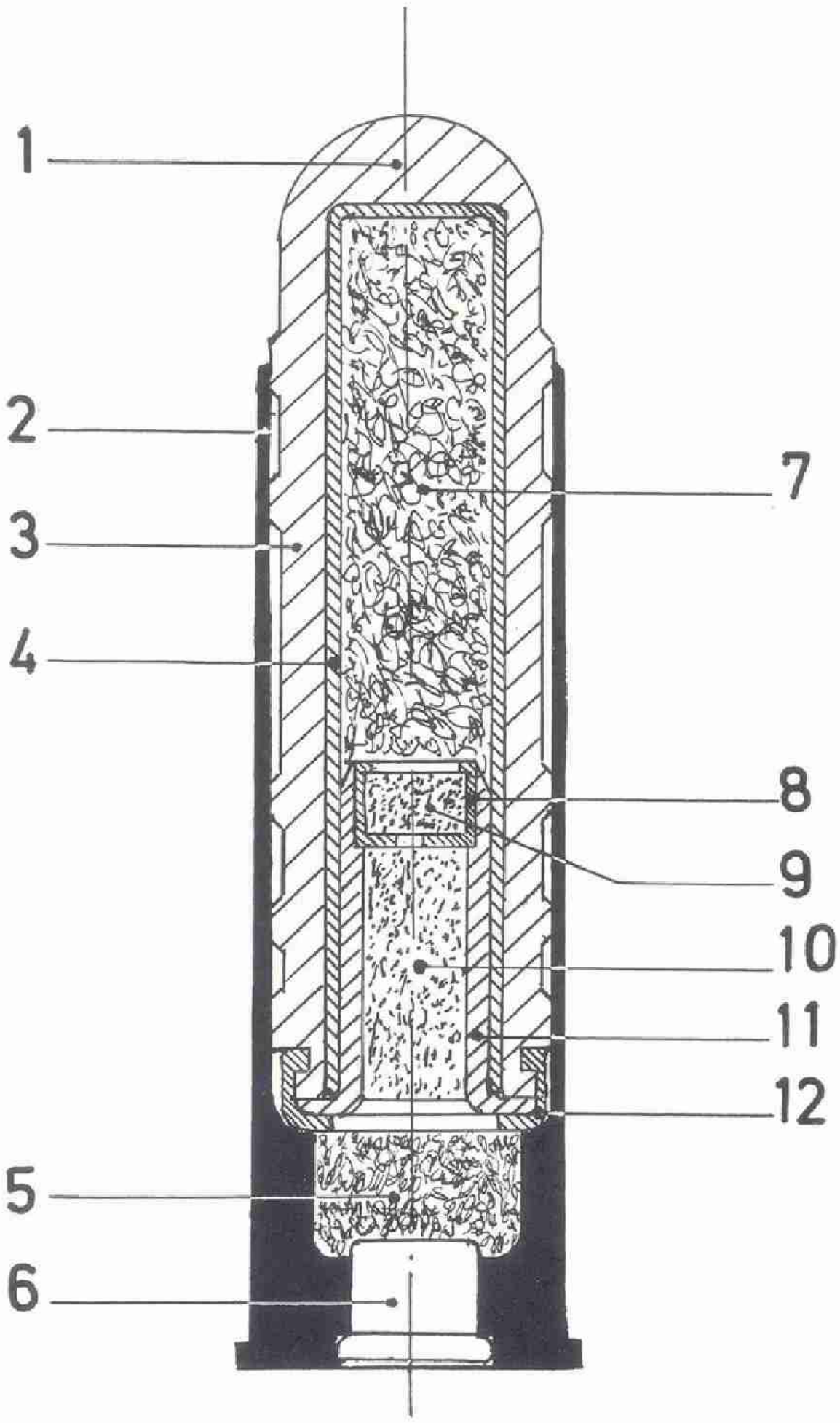
# 3. **Marking and Packaging of the Ammunition**

Each training cartridge has its type stencilled on its case wall, the lower printed line contains the name of the manufacturer, the lot number and the year of manufacture. The calibre designation and once again the name of the manufacturer are imprinted by stamp into the cartridge base.

Always 10 training cartridges are packed together into one cardboard box. The boxes are fitted with labels showing the types of ammunition they contain. Each full box weighs about 700 g. Generally 50 cardboard boxes (500 training cartridges) are wrapped together into plastics sheets and packed into wooden cases. Each full case weighs 38.5 kgs.

**Training Amunition 14.5 mm x 51 with Delay fuze**
**Key for figure 8**

**Übungsmunition 14,5 mm x 51 mit Brennzünder**




1 projectile
2 cartridge case
3 lead jacket
4 intermediate steel case
5 propellant composition
6 priming cap with primer
7 smoke composition
8 igniter case
9 ignition charge
10 time delay charge
11 delay casing
12 plastic base cap

FIGURE 8
ABBILD. 8

## 4. Technical and Ballistic Data Concerning the Ammunition

The training cartridge cal. 14.5 mm x 51 is supplied in the following 10 types:

| no. | fuze charge | weight: charge g | weight: projectile g | weight: case g | weight: cartridge g | lenght cartridge mm | muzzle V m/sec | max. firing range m | distance to bursting point m (app.) |
|---|---|---|---|---|---|---|---|---|---|
| | **impact fuze** | | | | | | | | |
| 1. | 1. charge | 0.2 | 59 | 10 | 69 | 65 | 100 | 730 | – |
| 2. | 2. charge | 0.3 | 59 | 10 | 69 | 65 | 125 | 990 | – |
| 3. | 3. charge | 0.34 | 59 | 10 | 69 | 65 | 135 | 1150 | – |
| | **delay fuze 3 sec** | | | | | | | | |
| 4. | 1. charge | 0.2 | 59 | 10 | 69 | 65 | 100 | – | 270 |
| 5. | 2. charge | 0.3 | 59 | 10 | 69 | 65 | 125 | – | 350 |
| 6. | 3. charge | 0.34 | 59 | 10 | 69 | 65 | 135 | – | 360 |
| | **delay fuze 6 sec** | | | | | | | | |
| 7. | 1. charge | 0.2 | 59 | 10 | 69 | 65 | 100 | – | 490 |
| 8. | 2. charge | 0.3 | 59 | 10 | 69 | 65 | 125 | – | 610 |
| 9. | 3. charge | 0.34 | 59 | 10 | 69 | 65 | 135 | – | 640 |
| | **maneuver cartridge** | | | | | | | | |
| 10. | | 0.5 | – | 10 | 11 | 51 | – | – | – |

# Part III
# Operation Instructions

## 1. General Information

Operation of the artillery trainer is very simple. With the help of these operation instructions it is easy to assemble the trainer. During firing it is recommendable to employ trained gun layers and gun loaders.

### 1.1. The Operating Crew

The operating crew for the artillery trainer consists of:

– 1 gun commander,
– 1 gun layer,
– 1 gun loader.

If there is no gun commander the gun layer takes over his tasks.

### 1.2. Transportation of the Artillery Trainer

For transportation the artillery trainer is – packed into the storage chest – loaded on a truck equipped with loading platforms. A 1.5-ton truck for instance can take up 6 full chests. Each chest is carried by four soldiers.

## 2. Preparation for Readiness of Operation

While moving into position the transporting vehicle approaches the firing position opposite to the direction of fire, so that the chest with the trainer can be pulled off the rear of the vehicle. The chest is carried to the fire point by 4 soldiers and deposited at right angle to the direction of fire.

### 2.1. Mounting of the Tripod

Both the gunners open the lid of the chest. The gun loader pulls out the wooden partition in the middle of the chest and puts it laterally into the chest. The tripod, now exposed, is taken out by the gun loader holding the tripod base and the gun layer holding the legs, and carried to the place designated by the commander.

The gun loader sets up the tripod in a way that the extendible rear leg points opposite to the direction of fire. He spreads the two front legs in direction of fire and drive them firmly into the ground until the spur lies flat on the ground. The height of the muzzle above ground shall be approx. 1.30 m since the calculations of the firing table are based on a muzzle horizontal of 1.30 m.

The gun loader has to watch that the tripod base is horizontal and to adjust the base plate position by alteration of the length of the extendible rear leg. Normally the extendible rear leg shall be approx. 30 cm extended. After rough horizontal adjustment of the tripod base the gun loader locks the extendible rear leg with the lower locking lever. He takes care that the upper edges of the adjusting sleeves coincide with the yellow marks at all three of the tripod legs, however in a way, that the marks are still fully visible. Then he tightens the locking lever so that the tripod legs are secured.

### 2.2. Fitting of the Mount

The gun layer grips the mount by the round timber piece, lifts it off the chest and places it on the top of the tripod base in a way that the key on the tripod base fits in the keyway on the bottom of the base mount. For this purpose he rotates the mount on the tripod base until he distinctly hears that the key fits. Now the base mount and the tripod base must be lying flat one against the other. The gun layer secures the mount to the tripod base by tightening the lock screw. Then he puts the round timber piece back into the chest.

The gun layer and the gun loader together roughly set the level vials on the upper mount by pressing the tripod legs into the ground and by adjusting the extendible rear leg. In order to do so the locking levers have to be loosened. The adjusting sleeves of the tripod legs must only be used during adjustment for setting the level vials.

## 2.3. Mounting of the Barrel with Breech

The gun loader removes the lower partition and lifts the barrel with breech out of the chest, opens the trunnion caps of the trunnion seats of the upper mount and inserts the barrel. During this operation he pulls the elevating handwheel of the elevating mechanism making sure, the teeth on the elevating gear sector at the barrel mesh properly with the elevating worm gear between the cheeks of the upper mount. He tightly presses the trunnion caps on the trunnions and locks them by tightening the tiltable lock knobs.

## 2.4. Fastening of the Elevating Laying Gear

The gun loader takes the elevating laying gear out of the leather pouch in the chest and pushes its square hole onto the extended square trunnion by turning the knurled knob clockwise so that the upper edge of the elevation scale and the zero mark of the mils marks run parallel to the barrel. The gun loader sets the mils marks in the window of the tiltable setting slide to zero, that is done as follows:

- by turning the micrometer screw for the level vial slide: 0 to 300
- by turning the knurled knob screw for the setting slide: 0 to 0.

## 2.5. Fastening of the Traversing Laying Gear and Checking of the Adjustment

The gun layer takes the socket for the traversing laying gear out of the chest and takes the panoramic telescope of the combat gun out of the corresponding case. He places the socket onto the bracket of the upper mount and secures it by tightening the locking screw. He inserts the panoramic telescope into the socket.

Then the gun layer checks the adjustment of the artillery trainer. For checking he adjusts the level vials on the upper mount by screwing off and on the adjusting sleeves at the tripod legs. Then he removes the bolt from the receiver and inserts the breech boresight into the breech and the crosshairs as muzzle boresight into the muzzle of the barrel.

These inserts can also be prepared by the troop. As breech boresight a fired cartridge case can be used perforated at the point pressed in by the firing pin and inserted into the chamber. Fine strings or threads can be placed crosswise over the grooves on the muzzle of the barrel.

Then the gun layer aims at a point at a distance of at least 450 m. He places the quadrant on the flat machined surface of the barrel and so determines the elevation of the barrel directed at the aiming point. He transfers the determined elevation to the elevation gear of the panoramic telescope and checks wether the target mark of the panoramic telescope by reference mark 0 points to the aiming point. If the deflection is greater then $\pm\ 1^{-}$, this has to be reported to the gun commander. The deflection has to be remedied by the maintenance personnel.

Subsequently the gun layer refers the azimuth on an aiming point according to the regulations valid for combat guns.

## 2.6. Termination of the Preparations

The gun loader puts the full ammunition boxes on the ground at the right-hand side of the trainer and checks the types of ammunition received.

Before firing takes place the gun loader removes the bolt from the receiver and checks the bore. He unoils the bore with the cleaning rod and with the cleaning patches, which he finds in the chest of the trainer. Then he again inserts the bolt into the receiver. Doing this he checks, wether the sear (guide bolt) of the trigger is lying firmly upon the surface of the receiver with its band so that the firing pin is correctly arrested. He eliminates foreign matters which are to be found between the band of the sear (guide bolt) and the bearing-surface of the receiver.

Then both the gunners close the chest and put it under cover. When all preparations are finished the gun layer reports readiness for operation of the artillery trainer to the commander.

## 3. Preparation for Readiness for Action and the Firing Activity

### 3.1. Traverse Setting

The gun layer sets the panoramic telescope to the ordered azimuth. Traversing takes place in the same way as with combat guns. For rough setting of the traverse direction the gun layer presses downward on the rapid traverse lever of the worm gear housing at the upper mount and turns the upper mount into the ordered direction. Then he lets the lever go and precision sets by turning at the traversing handwheel of the traversing mechanism.

### 3.2. Elevation Setting

The gun loader sets the ordered elevation at the elevation scale of the elevating laying gear by means of the setting slide, and the ordered level vial by means of the level vial slide.

For rough setting of the elevation angle the gun loader presses the knurled knob of the tiltable worm gear drive forward (looking in direction of fire) and turns the setting slide rougly to the ordered elevation. Then he lets the knurled knob go and precision sets the ordered elevation by turning the knurled knob. Owing to the vernier which passes inside the window of the setting slide across the mils marks precision setting up to an accuracy of $1^{-}$ is possible.

If another level vial as $300^{-}$ is ordered or calibration data of the barrel have to be compensated the gun loader must actuate the level vial slide. By turning the micrometer screw he sets the ordered level vial by means of the vernier with an accuracy of $1^{-}$.

If the quadrant of the combat gun is used to set the elevation instead of the elevating laying gear, the gun loader sets the quadrant to the ordered elevation according to the regulations valid for combat guns.

After total setting of the elevation angle the gun loader sets the rough elevation by lifting the locking plate at the upper mount and pulling the elevating handwheel, disengaging the elevating worm gear from the elevating gear sector and swivelling the barrel roughly into the ordered elevation. After rough elevation setting he releases the pulling on the elevating handwheel, closes the locking plate in its former position, and precision sets the elevation by turning at the elevating handwheel until the bubble of the level vial slide or of the quadrant reaches equipoise.

### 3.3. Loading and Firing

For **loading** the gun loader turns the breech bolt lever to the left in vertical position and pulls the bolt to the rear. Then he takes the ordered type of ammunition out of the box and places the cartridge into the receiver. Then he pushes the bolt with the cartridge forward and pushes the breech bolt lever back to the right until it strikes the stop. Only if the breech bolt lever is in this locked position the trigger can be pulled and firing takes place.

The gun loader checks wether the safety ring is set to the red letter "F" (fire). After inserting of the cartridge and closing of the bolt the artillery trainer is ready to fire. In this case the firing pin spring guide with the red dot protrudes from the breech bolt screw.

After receipt of the **firing order** the gun loader depresses the trigger. He holds the receiver end with the thumb and forefinger of his left hand and depresses the trigger with the right side of his forefinger. He must take care to press even his thumb and forefinger together thus preventing lateral movement of the barrel. After firing he opens the bolt and pulls it all the way to the rear so that the cartridge case is ejected.

If firing is interrupted without unloading, the gun loader locks the breech turning the safety ring to the left towards the letter "S" until it strikes the safety stop screws. For unlocking he turns the safety ring into the opposite direction until the mark points to the letter "F".

During the pause in firing, at least however after every 25—30 shots, the gun loader **cleans the barrel** with the brass brush and if necessary also with the steel wire brush in order to remove all lead or powder residues.

## 4. Gun Displacement

Upon the command "gun displacement" both the gunners fetch the chest and open it. They **clean** the artillery trainer of dust and dirt. The gun loader always cleans the barrel after firing to remove lead and powder residues and oils it. Then he repacks the unused ammunition into the boxes.

The gun layer sets the traversing laying gear back to zero, the gun loader sets the elevating laying gear to zero and the level vial slide to 300. Then the gun layer takes the panoramic telescope off the socket and puts it back into the corresponding case. He loosens the locking screw at the bracket of the upper mount, dismantles the socket and packs it back into the chest. The gun loader turns counterclockwise the knurled knob with which the elevating laying gear was fastened to the right trunnion, disconnects the elevating laying gear and hands it to the gun layer who puts it into the pouch in the chest.

Subsequently the gun loader removes the barrel. In order to do so he loosens the tiltable lock knobs and opens the trunnion caps, he turns the rapid elevating locking plate at the upper mount, pulls the elevating handwheel of the elevating mechanism and lifts the barrel off its bearings. Then he closes the locking plate, puts the barrel into its support in the chest and locks it by means of the lower partition.

The gun layer fastens the round timber piece at the trunnion seats of the upper mount, loosens the mount locking screw below the tripod base and lifts the mount off the tripod base. He carries the mount – holding it by the round timber piece – to the chest and fits it onto the plate on the chest bottom. During this operation he inserts the round timber piece into the supports at the chest walls and fastens the mount for transportation.

The gun loader loosens the locking levers of the tripod, pushes the extendible rear leg together, pulls the tripod legs off the ground and cleans the tripod of sand and dirt. Then the gun loader and the gun layer together put the tripod back into the chest. The extendible rear leg must be put into the middle bearing bush of the chest. The pointed ends of the tripod legs must point towards the mount. The gun loader inserts the upper partitions into the corresponding brackets, so that the upper recess of the partition board is directed towards the lid of the chest.

The gun commander convinces himself that the artillery trainer has been duely cleaned and is packaged and complete as described.

Both the gunners close the lid of the chest and lift it onto the transporting vehicle together with two other soldiers.

# Part IV
# Maintenance Instructions

## 1. Maintenance and Care Effected by the Operating Crew

Thorough maintenance and care of the artillery trainer is a prerequisite for troublefree operation and for accurate firing.

### 1.1. Storage Chest

The exterior finish of the storage chest, particularly of the bottom and the iron fittings must be regularly renewed so that they are always protected against dampness and corrosion. The inner walls and partition boards must be treated with linseed oil once a year, the hinges have to be oiled as occasion demands. Worn-out or damaged stripes of felt have to be replaced.

### 1.2. The Tripod

All mobile, rotary and bright parts have to be cleaned and slightly oiled after use of the artillery trainer.

### 1.3. Upper Mount

For cleaning the upper mount has to be removed from the base mount. In order to do so the mount locking plunger below the elevating handwheel of the elevating mechanism at the upper mount must be pulled out and held against the pressure of the spring. The base and the straining screw must be oiled after having been cleaned with a cloth and a brush. The worm wheel gear for the traversing mechanism has to be greased with vaseline.

The spring loaded worm gear bracket of the elevating mechanism with the bevel gears and the worm as well as the elevating gear sector at the barrel and the receiver must be carefully cleaned and greased with vaseline. The two spring-loaded plunger can be oiled when the upper mount is in a slightly inclined position.

It has to be checked that the guide pilots at the bracket and the corresponding bore in the socket of the panoramic telescope operate freely, these items must be greased with vaseline. All metal and brightly polished parts as well as the trunnion seats must be slightly greased with vaseline. All other mobile and polished parts have to be slightly oiled.

### 1.4. The Barrel with Breech

Before firing the barrel must be wiped with the cleaning rod and the cleaning patches from the chest, for it has to be free of oil and foreign matters, powder residues and lead deposits. During firing the barrel must be cleaned with the brass brush and if necessary also with the steel wire brush after every 25–30 shots, so that it is free of lead residues. After firing the bore must be thoroughly cleaned and slightly oiled.

The receiver has to be cleaned of dust with the hair brush. The trigger has to be thoroughly checked for proper functioning. The sear (guide bolt) of the trigger must lie firmly with its band upon the surface of the receiver in order to prevent correctly any disengagement of the sear (guide bolt) from the firing pin. Foreign matters have to be carefully eliminated with the hair brush or an appropriate tool whereby the sear (guide bolt) has to be extracted at its band from the receiver sleeve.

The bolt has to be cleaned and oiled disassembled.

Any trouble or failure to fire occuring during firing may be due to:

a) A broken point of firing pin,

b) a broken firing pin spring,

c) a damaged extractor.

The spare parts belonging to a) to c) are to be found in the plastic bag in the storage chest.

**Checking points:**

Ref. to a) and b): The priming cap of the loaded cartridge was not or not sufficiently hit, therefore the failure.

Ref. to c): The cartridge case is stuck in the chamber.

**Corrective action:**

Ref. to a) and b): The bolt is removed and disassembled by turning the bolt screw counterclockwise. Defective parts must be replaced by spare parts.

Ref. to c): After removel of the firing pin spring guide the spare extractor and the extractor spring have to be inserted **(attention** to the extractor spring during disassembly!).

The two trunnions and the square trunnion of the elevating laying gear must be carefully cleaned and slightly oiled. In the same way all mobile and brightly polished parts must be oiled after cleaning.

### 1.5. Elevating and Traversing Laying Gears

The elevation scale, the setting slide and the level vial slide have to be cleaned of dust with the cleaning hair brush. The browned surfaces of these parts should **not** be oiled. The gear rim should be slightly greased with vaseline, the clamping nut, the threaded spindle and the square guide should be slightly oiled.

The panoramic telescope and the quadrant have to be maintained according to the maintenance instructions valid for the troop.

### 1.6. Cleaning Equipment

The cleaning equipment and in particular the patch holders as well as the wire and hair brushes have to be cleaned in regular intervals in liquid solvents such as gasoline used for cleaning purposes. Worn cleaning devices and expendable supplies (such as oil, grease, cleaning patches) must be replaced in time.

### 1.7. Tools

The tools in the storage chest must always be slightly oiled and kept in operative and clean condition.

## 2. Checking Operations Carried out by Organizational Maintenance Personnel (second Echelon)

The following checking operations have to be carried out by the organizational maintenance personnel:

- checking of the exterior condition,
- checking for correct functioning and
- adjustment checking.

### 2.1. Checking of the Exterior Condition

The maintenance personnel examines the artillery trainer with consideration to the hints for the operating crew given in part IV, 1. Discovered damages have to be corrected.

Spare parts can be supplied by the manufacturer using the spare parts catalogue, if they are not contained in the maintenance and supply stores of the military forces.

### 2.2. Checking for Correct Functioning

When checking correct functioning the following points must be taken into consideration:

(1) Is the tripod adjustable and can it be firmly fixed in any position?

(2) Can the elevating mechanism be smoothly operated without backlash?
Re-adjustment can be carried out by means of the adjusting screw. Backlash of the bevel gears can be compensated by tightening the adjusting screw at the drive shaft exit.

(3) Can the traversing mechanism be smoothly operated without backlash?
Re-adjustment can be carried out by means of the set screw.

(4) Can the bolt be easily inserted and removed?

(5) Does the firing pin operate smoothly in the bolt?
Residues of grease in the bolt could possibly breake the forward movement of the firing pin and cause failure to fire during firing.

(6) Is the bolt properly locked by turning the breech bolt lever?

(7) Is it possible to put the bolt at safety so that no firing can take place?

(8) Are the cartridges and empty cartridge cases extracted without trouble?

## 2.3. **Adjustment Checking**

Adjustment checking requires the following operations:

- The artillery trainer is levelled with the help of the level vials on the upper mount. If the upper mount is rotated through 1600⁻ the level vials must still show level position.
- For checking the vertical adjustment the bolt is removed from the receiver. A breech boresight is inserted into the breech and crosshairs are inserted as muzzle boresight into the muzzle of the barrel. At a distance of 6 cm in front of the barrel muzzle a plumb line support with plumb line has to be mounted. To the plumb line a plumb bob or a weight must be fixed and hung into a bucket of water or waste oil. By lateral displacement of the support the plumb line is set to the axis of the bore. Then the barrel is moved through the total of the elevation range from 0⁻ to 1600⁻. Maximum deflection of the axis of the bore from the vertical plane (plummet line) admissible is 2⁻. Otherwise there must be a defect at the trunnion seats.
- For checking the elevating laying gear the quadrant — set to zero — is positioned on the flat machined surface of the barrel, and with its help the barrel is levelled. Horizontal adjustment is checked by reversal of the quadrant. After setting the zero mark of the setting slide at the elevating laying gear to 0 and the zero mark of the level vial slide to 300 the level vial at the level vial slide must be levelled. Deflection of the elevation must be not more than 2⁻ and of the angle of site not more than 1⁻ from the barrel elevation set with the quadrant.
- The axis of the socket for the panoramic telescope fixed at the bracket must be perpendicular to the horizontal plane. For checking this the checking bar supplied with every 5th artillery trainer must be pushed into the socket. The quadrant is mounted onto the checking bar and thus the horizontal position is checked in the direction of fire and at right angle to the direction of fire. Care has to be taken that the level vials on the upper mount are levelled.
- The optical zero axis of the panoramic telescope must coincide with the axis of the barrel bore. At short distance this is checked with the adjustment table, at long distance with the distant aiming point.

(1) For adjustment at short distance the adjustment table is hung at a distance of approx. 20 m in front of the barrel muzzle (table adjustment method). The panoramic telescope with its azimuth and elevation scales set to 0 is inserted into the socket. The axis of the barrel bore is aimed at the right-hand aiming cross of the adjustment table. Now the sight in the panoramic telescope must point to the left aiming cross of the adjustment table. In the case of a lateral deflection the panoramic telescope is adjusted by using the tangent screws on the socket and fixed in this position by tightening the setcrews. The tangent screws must only be tightened to a degree which allows for free removal of the panoramic telescope from the socket.

(2) For adjustment at long distance (distant aiming point method) the muzzle crosshairs must be aligned with the most marked spot of a point at a distance of at least 450 m. The barrel elevation is checked by mounting the quadrant onto the flat machined surface of the barrel. The barrel elevation thus determined is set at the elevation scale of the panoramic telescope. Now the sight of the panoramic telescope must point to the same marked spot of the aiming point. In the case of a determined lateral deflection the same procedure as for table adjustment has to be followed.