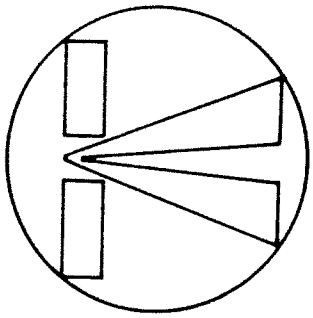
OPERATING MANUAL

for the

USK6

ULTRASONIC FLAW DETECTOR



KRAUTKRAMER-BRANSON, INCORPORATED
a SmithKline company
STRATFORD, CONNECTICUT

IMPORTANT NOTICE

READ THE FOLLOWING INFORMATION PRIOR TO USE OF ANY KRAUTKRAMER-BRANSON INSTRUMENTS.

Krautkramer-Branson operation manuals provide functional information about a particular instrument or group of instruments. Proper setup and use of the instrument and performance of ultrasonic tests, however, requires familiarity with factors that are beyond the scope of operation manuals. These factors include selection of appropriate cable(s) and transducer(s), preparation of test surface, choice of couplant, characteristics of the test material, environmental factors such as temperature and electrical interference, interpretation of test results, as well as individual factors that will depend upon the particular test object and test performed.

Consequently, it is imperative that operators are properly trained both in general ultrasonic testing procedure and in the setup and performance of the particular test to be performed. Training of ultrasonic test operators and assurance that tests are performed properly is the responsibility of the instrument user. Similarly, compliance with industry specifications such as ASTM, ASNT, MIL STD, API, etc. is the responsibility of the user.

An experienced test operator can state the location and "equivalent size" of a flaw in a test material. However, the decision whether a part is defective must be based on an analysis provided by qualified technical personnel.

Periodic calibration and maintenance are necessary to assure the accuracy of the instruments. Incidents, such as dropping the instrument or probe, can adversely affect accuracy. The instrument must be recalibrated and rechecked after any such incident. Periodic cleaning and maintenance by qualified personnel can also help to assure accuracy and proper functioning of the instrument.

The instrument must be calibrated with a test specimen of known thickness and having precisely the same acoustic velocity and characteristics as the material to be tested. Instrument calibration should be checked frequently during testing to assure accurate measurements.

Ultrasonic waves are reflected from the interface between two dissimilar materials, for example between metal and air or metal and water. When measuring the thickness of multilayer, overlapping, threaded, or the like test specimens, only the thickness of the material acoustically coupled to the probe will be measured since the ultrasonic wave will be reflected at the interface of the material and the next layer. The ultrasonic wave will not penetrate into the subsequent layer of work specimen. Therefore, only the thickness of the layer contacted by the probe is measured.

If you have any questions about the use, operation, specifications or special considerations relative to your particular Krautkramer-Branson instrument, contact your local sales representative, or our main office.

WARRANTY

When used in accordance with the manufacturer's written instructions and under normal operating conditions, KRAUTKRAMER-BRANSON, INCORPORATED (KB) test instruments are guaranteed to be free from defects in material and workmanship, for a period of one (1) year from date of shipment. KB will repair free of labor and material charges any unit which proves defective within 90 days from date of original shipment by KB or by an authorized representative or distributor, and during the remainder of the one-year period KB will replace or repair defective parts or defective workmanship, customer to pay labor charges only.

All repair work will be made F.O.B. Stratford, Connecticut, or at an authorized repair station as advised by KB, provided the defective unit is returned properly packed with all transportation charges prepaid. Any and all equipment replacement will be at the sole discretion of KB.

This warranty shall not apply to equipment subjected to misuse or abuse, improper installation, alteration, neglect or accident. Excluded from this warranty coverage are expendable items such as transducers, interconnecting cables, batteries, and vacuum tubes when used in the instrument. Accessory items such as recorders, etc. will be covered under the original manufacturer's warranty as given to KB.

This warranty is limited to the original purchaser and is not transferable. No other warranty, either expressed or implied is made.

SERVICE

Should service become necessary, KB has established a number of authorized Service Centers throughout the United States and Canada. For the location of the nearest facility, contact:

Manager, Repair Department
Krautkramer-Branson, Incorporated
250 Long Beach Blvd.
Stratford, Connecticut 06497
Telephone: 203/377-3900

Comments or questions concerning this manual should be directed to:

Technical Publications Department
Krautkramer-Branson, Incorporated
250 Long Beach Blvd.
Stratford, Connecticut 06497

USK6
OPERATING MANUAL

I. Introduction

1-1 The Krautkramer-Branson USK6 is a portable, ultrasonic flaw detector. It combines the most important, and necessary, functions of a flaw detector.

1-2 Of course, proper training is necessary to evaluate the readings obtained by any flaw detector, but this Manual has been designed to make the operation of the USK6 as simple as possible. The Manual is divided into two sections. The section titled "Front Panel Controls, Indicators and Connectors" will acquaint the operator with the location and function(s) of the controls. The "Instrument Familiarization" section is designed to make the operator comfortable with the operation of the controls, and familiar with the results of those operations.

1-3 Read this Manual thoroughly before using the USK6.

1-4 Technical Data and Specifications

Frequency Range:	0.5 MHz to 10 MHz
Gain:	coarse 0/20/40 dB fine 0 - 40 dB in increments of 2 dB
Reject:	adjustable from 0 to approx. 30% of the CRT screen height
CRT Screen Indication:	linear display of the echo amplitudes
Horizontal Linearity:	non-linearity: < ± 1% of the total measuring range. temperature drift: 2% per 10°C
Vertical Linearity:	within ±3%;
Testing Range:	.98 in - 98 in. (25mm - 2.5mm) steel; continuously adjustable
Pulse Shift:	0 - 9.8 in. (0 - 250mm) steel temperature drift is 1% per 10°C
Pulse Repetition Frequency:	coupled to the testing range, 1 kHz with 1X (.98 in.) and 250 Hz with 10X (98 in.) steel. tolerance: ±5%
Monitor:	single-channel monitor with "Yes/No" coincidence output (positive logic); can be switched internally to anti-coincidence (negative logic)
Monitor Gate:	The gate width (end of the gate) is adjustable from 0 to 50% of the CRT screen width. The gate delay (start of the gate) is adjustable from the start of the base line (minimum .2 in. steel in the 1X range) to the end of the base line The adjusted position is maintained almost independently of the testing range
Monitor Threshold:	fixed at 2/5 CRT height (40%)
Monitor Signal Generation:	YES/NO indication with luminous diode. Additional output (for second luminous diode or earphone) output voltage: 8V; internal resistance: 330 ohm
Batteries:	1 battery set consisting of 6 "D" size rechargeable nickel cadmium (NiCad) cells (NCA 2-6) If the above mentioned batteries are not available, or are discharged: 6 drip-proof mono-cells (e.g. alkali-manganese or similar type non-rechargeable dry cells)

Power Consumption:	approx. 4 Watts
Operational Life:	approx. 8 hours with nickel cadmium (NiCad) cells NCA 2-6; with dry cells: approx. 5 hours with "alkali-manganese" cells; approx. 2.5 hours with "super-dry" cells; 2 hours or less with other types of dry cells
Charging the Batteries:	by means of an external charger suitable for charging the batteries: 1) in the equipment and 2) outside the equipment in the charging frame UK 685
Battery Charge Check:	by means of the indicator and the automatic switch-off device
Fuse:	0.8A slow (for changing the fuse see paragraph 2-62)
Ambient Temperature Range (instruments)	−15° to +40°C
CRT Screen Scale:	2.75 x 2.2 in. (70 x 55mm) with internally scribed graticule
Instrument Dimensions:	3.75 x 9.5 x 12 in. (95 x 240 x 300mm) (HxW xD)
Weight:	10.78 lb. (4.9 kg) with batteries

USK6 Standard Package

- USK6 instrument, which includes the instrument itself, UK661 screen overlay scale, carrying strap, protective cover, and operating instructions
- Battery Charger
- Six "D" size NiCad Batteries
- Spare fuses (5)
- Screwdriver

Options Recommended for Operation

- Lightshield
- Coarse Attenuator (Plug In)
- Battery Charging Frame
- BBCL-6 cable (6' BNC-BNC)
- Earphone alarm (MH5)

Other Available Options

- Service instructions
- Pocket blue book on ultrasonic testing methods
- KA314 Shipping/carrying case. Aluminum with special foam-padded interior

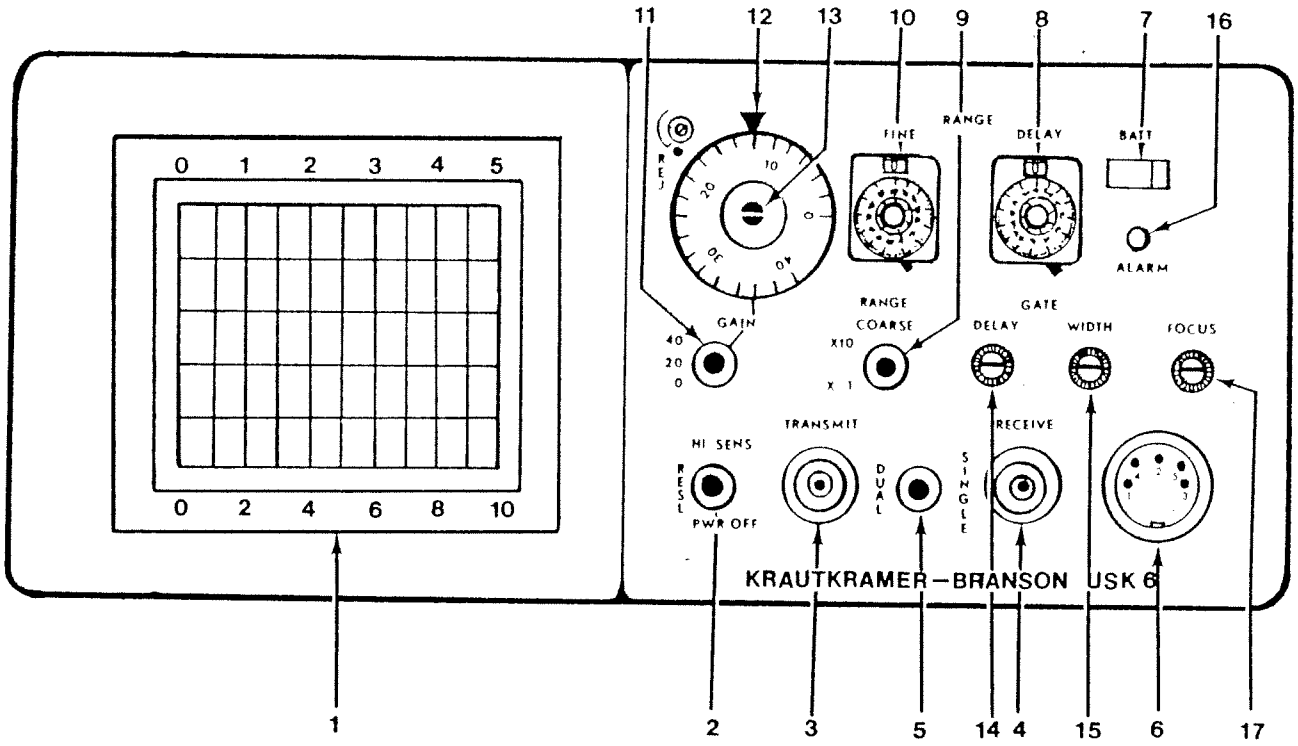


Figure 1-1 Instrument Controls

1-5 Front Panel Controls, Indicators and Connectors

1-6 Cathode Ray Tube

(CRT) Screen (1)
Provides a video display of test information.

1-7 PWR OFF-RESL-HI SENS (2)
(Power On-Off Switch/Damping Control)

This dual function control serves as a Power On-Off Switch and Damping Control. The instrument is Off in PWR OFF position and On in the other positions. The RESL position provides high damping for increased resolution; the HI SENS position provides lower damping for increased sensitivity.

1-8 TRANSMIT Connector (3)

When the Transducer Mode Switch (5) is in the DUAL position, the Transmit Connector (3) connects the transmitting transducer cable to the instrument transmitter output. When the Transducer Mode Switch (5) is in the SINGLE position, the Transmit Connector connects the transducer to both the transmitter output **and** the receiver input for pulse-echo operation.

1-9 RECEIVE Connector (4)

When the Transducer Mode Switch (5) is in the DUAL position, the Receive connector connects the receiving transducer cable to the instrument receiver input. When the Transducer Mode Switch (5) is in the SINGLE position, the Receive Connector connects the transducer to both the transmitter output **and** receiver input for pulse-echo operation.

1-10 SINGLE-DUAL (5)
(Transducer Mode Switch)

The DUAL position sets the instrument for paired transducer tests, such as thru-transmission or dual probe pulse-echo tests. The SINGLE position sets the instrument for single probe pulse-echo testing.

1-11 Dual Purpose Connector (6)

This Multi-contact connector functions both as an AC Power/Battery Charger input and as a Gate Alarm output. The connector has five pins, used as follows: pins 1 and 3 are the gate alarm output (pin 3 is the ground connection); pin 2 is the positive battery connection and pin 3 is the negative battery connection; pin 4 is the charger output sense point; pin 5 is unused.

1-12 BATT (7)
(Battery Condition Indicator)

Meter showing the condition of rechargeable batteries. When the pointer is in the green area, the battery voltage is sufficient to operate the instrument. When the pointer is in the white or red area, batteries need to be recharged.

1-13 DELAY Control (8)

Adjusts the initial pulse relative to the start of the sweep. Echoes can be moved across the horizontal scale of the CRT screen without changing the distance between echoes. When the appropriate setting for a particular test has been adjusted, the control can be locked in position.

1-14 COARSE RANGE Control (9)

Adjusts the coarse range of the horizontal sweep. With COARSE RANGE Control in X1 position, the FINE RANGE Control (10) adjusts the horizontal sweep range from (approximately) 1" to 10" in steel. With the COARSE RANGE Control in X10 position, the FINE RANGE Control (10) adjusts the horizontal sweep range from (approximately) 10" to 100" in steel.

1-15 FINE RANGE Control (10)

Works in conjunction with the COARSE RANGE Control to calibrate the horizontal sweep for a particular material, wave mode and range. When the appropriate setting for a particular test has been adjusted, the control can be locked in position.

1-16 GAIN 0/20/40 (11)
(Coarse Gain Control)

Provides calibrated gain adjustment in increments of 20 dB from 0 to 40 dB.

1-17 GAIN 0-40 (12)
(Fine Gain Control)

Provides calibrated gain adjustment in increments of 2 dB, from 0 to 40 dB.

1-18 REJECT Control (13)

Recessed screwdriver adjustment for suppression of undesired low amplitude signals. The Reject Control affects CRT dynamic range and vertical linearity. The Reject is Off in the fully counterclockwise position. Rotation to the fully clockwise position provides approximately 30% suppression of echo signals.

Note: Always reset the Reject Control to Off position after use to restore vertical linearity to the CRT display.

1-19 GATE DELAY (14)

Positions the starting point of the gate. The gate may be used to scrutinize a particular, critical segment of the test piece, or to monitor the echo from the backwall of a test piece.

1-20 GATE WIDTH (15)

Continuous rotation control for switching the gate On or Off and adjusting the width or time duration of gate. (Positions the end of the gate.)

1-21 ALARM Indicator Light (16)

L.E.D. lights when the gate alarm is triggered. The ALARM is factory-set for positive logic (ALARM is triggered when the height of an echo within the gate exceeds the 40% screen height threshold level). The ALARM can be internally switched to negative logic (ALARM is triggered when the height of an echo within the gate falls below the 40% screen height threshold level). See paragraph 2-65 for instructions on changing gate triggering from positive logic to negative logic.

1-22 FOCUS Control (17)

Adjusts the sweep trace for the sharpest image.

II Instrument Familiarization

2-1 Instrument Familiarization

2-2 Preliminary Control Settings

2-3 PWR OFF-RESL-HI SENS (2)
(Power On-Off Switch/Damping Control)

Set to **RESL** position

2-4 TRANSMIT Connector (3)

Connect the coaxial transducer cable to the BNC connector. Connect a mid-frequency probe (2-6 MHz, 5 MHz preferred) to the other end of the cable.

2-5 RECEIVE Connector (4)

No connection required

2-6 SINGLE-DUAL (5)

Transducer Mode Switch
Set to **SINGLE** position

2-7 BATT (7)
(Battery Condition Indicator)

No setting is possible. However, the pointer should be in the green area indicating sufficient battery voltage for instrument operation. If the pointer remains in the red or white area, refer to para. 2-55 of this manual for instructions. Then return to this section and continue with instrument familiarization procedure.

2-8 Cathode Ray Tube (1)
(CRT Screen)

No setting is required. However, a horizontal sweep trace should appear across the bottom of the CRT Screen shortly after the instrument power is switched on.

2-9 DELAY Control (8)

Turn clockwise or counterclockwise, as required, until the Initial Pulse appears at left side of CRT Screen. (1)

2-10 COARSE RANGE Control (9)

Set to **X1.**

2-11 FINE RANGE Control (10)

Turn the control fully counterclockwise

2-12 GAIN 0/20/40 (11)
(Coarse Gain Control)

Set to 0

2-13 GAIN 0-40 (12)
(Fine Gain Control)

Set to 0

2-14 Reject Control (13)

Insert screwdriver into opening and turn fully counterclockwise.

2-15 GATE DELAY (14)

Turn the control fully clockwise

2-16 GATE WIDTH (15)

No setting required.

2-17 ALARM (16)

Light should be OFF. If it is ON, adjust the GATE DELAY (14) and GATE WIDTH (15) until the light goes Off and the gate "step" on the baseline disappears from view.

2-18 FOCUS (17)

Adjust for the shapest possible CRT trace.

Familiarization Procedure

2-19 Place a small amount of couplant on the surface of a 1" thick steel or aluminum block and couple the probe to the surface.

2-20 Adjust the Fine dB Gain Control (12) so that several echoes appear on the CRT Screen (1). (The actual number of echoes displayed is unimportant at this point.) These echoes represent reflections from the back surface of the test material, as shown in Figure 2-1. Observe the effect of adjusting the Fine Gain Control (12). Note that this is a "stepped" control. Each step changes the gain by 2 dB (decibels). Decibels, in this case, are a unit of measure for gain.

2-21 Rotate the Coarse Gain Control (11) thru the 0/20/40 dB positions. Note that this causes large changes in echo amplitude. Now reset this control to the 0 dB position.

2-22 With a screwdriver inserted into the opening, turn the Reject Control (13) clockwise and then fully counterclockwise. Note that the proportional relationship between echo heights (vertical linearity) changes as the Reject Control is turned. Reset the Reject Control to the fully counterclockwise position.

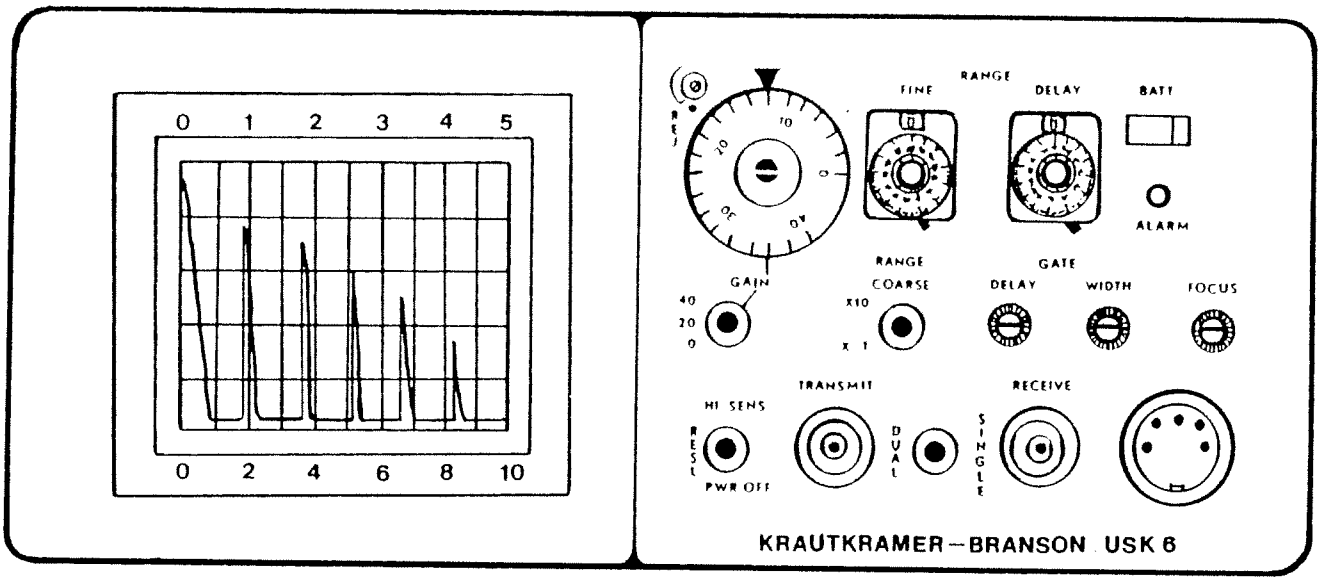


Figure 2-1 Backwall Echoes

2-23 Move the Power ON-OFF Switch/Damping Control (2) from RESL to HI SENS and then back to RESL. Note that the width of the initial pulse changes as you do this. This is because the Damping Control changes the duration of the initial pulse that is transmitted into the test material.

2-24 Move the Transducer Mode Switch (5) to DUAL. Note that the echoes are no longer displayed on the CRT. This is because in this mode the TRANSMIT connector (3) is connected only to the transmitter circuit and the RECEIVE connector (4) is connected only to the receiver circuit. If you were to connect another probe and cable to the RECEIVE connector (4) and place that probe on the opposite side of the test material as shown in Figure 2-2 or employ a dual-element probe as shown in Figure 2-3 received signals would again be displayed on the CRT screen.

2-25 Rotate the DELAY Control (8) clockwise and counterclockwise. Note that the presentation of the initial pulse and echoes is shifted to the left and right on the CRT screen. Observe that adjustment of the DELAY control has no effect on the spacing between signals displayed on the CRT screen. Readjust the DELAY Control so that the initial pulse returns to the left side of the CRT.

2-26 Turn the FINE RANGE Control (10) clockwise and counterclockwise. Note that this changes the spacing between signals displayed on the CRT screen.

2-27 Move the COARSE RANGE Control (9) from X1 to X10 and then back to X1. Note that this causes large changes in the spacing between signals displayed on the CRT screen.

2-28 Turn the FOCUS Control (17) clockwise and counterclockwise and observe that this blurs the trace. Readjust the FOCUS for the sharpest possible trace.

2-29 Turn both the GATE DELAY Control (14) and GATE WIDTH Control (15) fully counterclockwise.

2-30 Turn the GATE WIDTH Control (15) clockwise. Note that this causes a "step" signal to appear on the horizontal base line. Note also that continued rotation of the GATE WIDTH Control causes the trailing (right hand) edge of the step to move to the right, thus increasing the width of the step.

2-31 Turn the GATE DELAY Control (14) clockwise and counterclockwise. Note that this causes the leading (left) edge of the step to move right and left, thus changing the starting point of the gate.

2-32 Practice the above-described control manipulations until you are thoroughly familiar with the effect of each control. Complete familiarity with the controls will greatly simplify your work with the instrument.

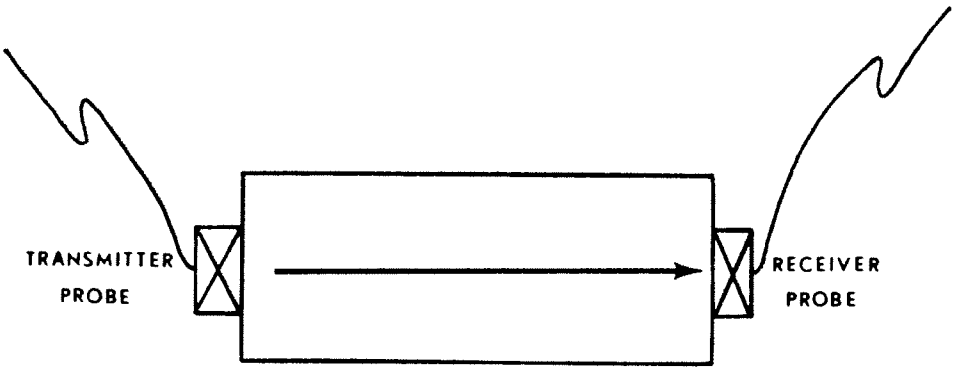


Figure 2-2 Through Transmission

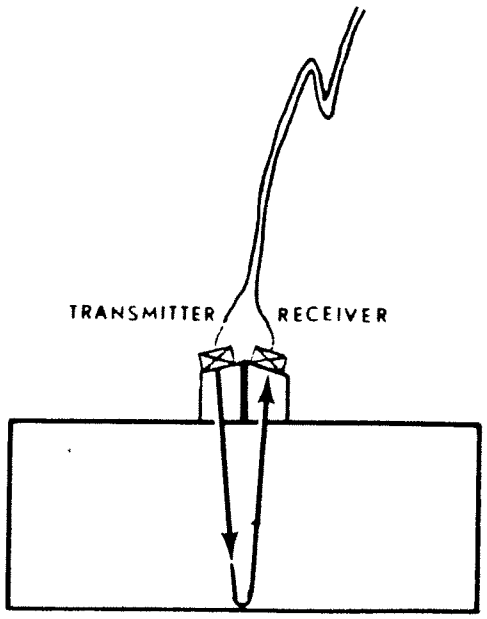


Figure 2-3 Dual Element Probe

2-33 Opening the USK6 (See Figure 2-4)

2-34 Certain functions, such as changing a fuse (see 2-62) or switching the gate logic (see 2-65), can only be carried out when the instrument is opened. Always disconnect the USK6 from its power source before opening the instrument.

2-35 Place the instrument face down on a smooth surface and remove the batteries from the battery compartment according to paragraph 2-55. Then undo both the screws (19) in the bottom of the battery compartment. Take hold of the front panel frame under one of the pivots on the carrying handle and draw the instrument housing upwards from the front panel holder.

2-36 Maintenance

2-37 The USK6 is battery operated and the batteries can be recharged inside or outside the instrument (see below).

2-38 Charging the Batteries

2-39 Charger: The charger is delivered set at 115 VAC.

2-40 Dry Cells: Discharged dry cells should be immediately discarded and under no circumstances should they be recharged!

2-41 Charging the Batteries Inside the Instrument

2-42 Connect the charger to charging socket in lower right corner of the USK6 front panel (Figure 1-1 item 6).

2-43 Connect the charger plug to an electrical outlet.

2-44 Start to charge. (Charging begins automatically.)

2-45 Charging Time: with six discharged "D" size NiCad (nickel cadmium) cells (NCA 2-6) maximum charging time is 14 hours.

2-46 Note: The charger is supplying a full charge to the batteries whether the instrument is switched on or off. The charger may remain connected to the instrument.

2-47 Charging the Batteries Outside the Instrument in the Charging Frame (UK685)

2-48 Connect the charger to charging socket of the charging frame.

2-49 Connect the charger's plug to an electrical outlet.

2-50 Start to charge. (Charging begins automatically.)

2-51 Charging Time: See 2-45 above.

2-52 Note: While you are using the instrument you can recharge your discharged batteries in the charging frame (UK685) independently from the USK6.

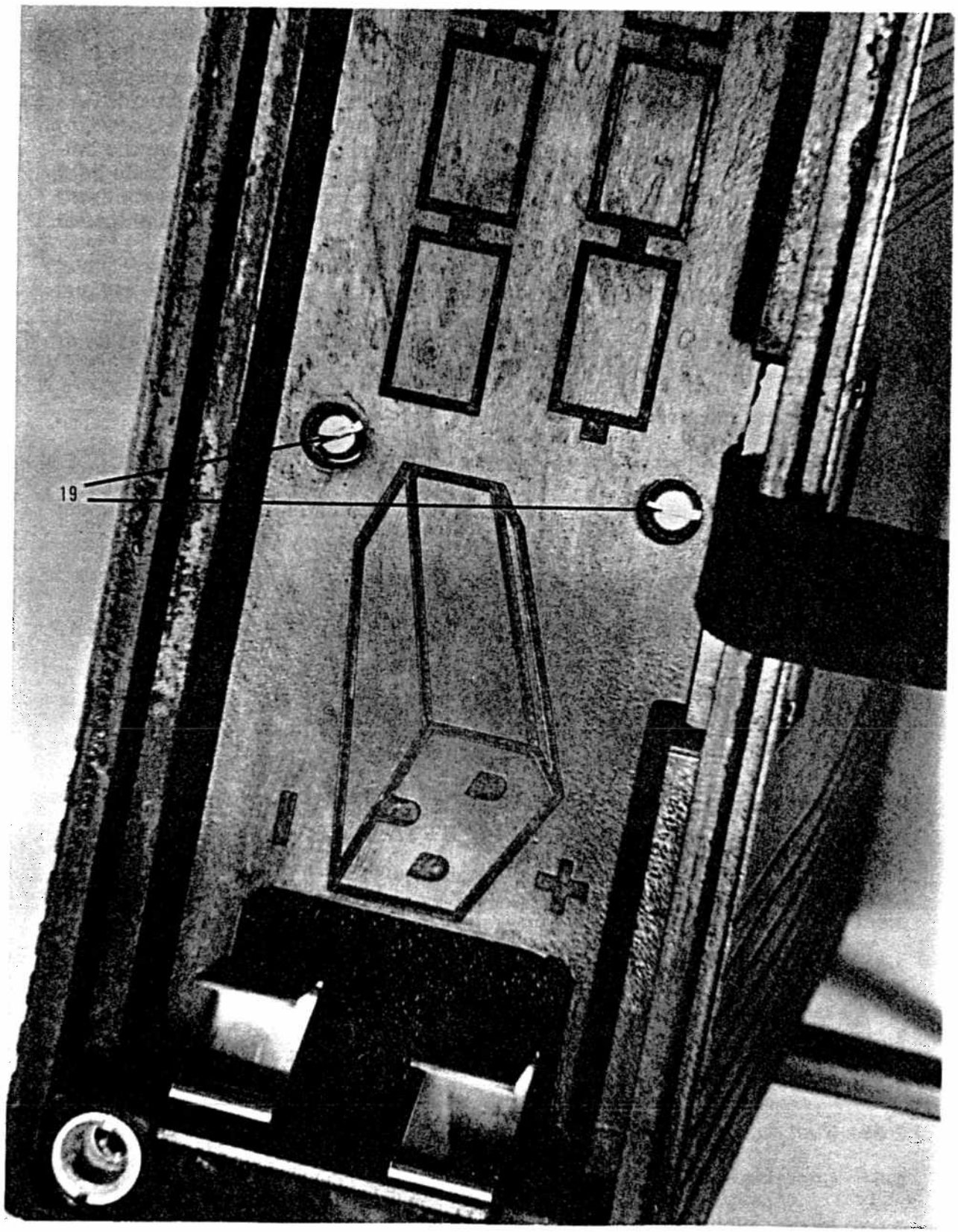


Figure 2-4 Battery Compartment

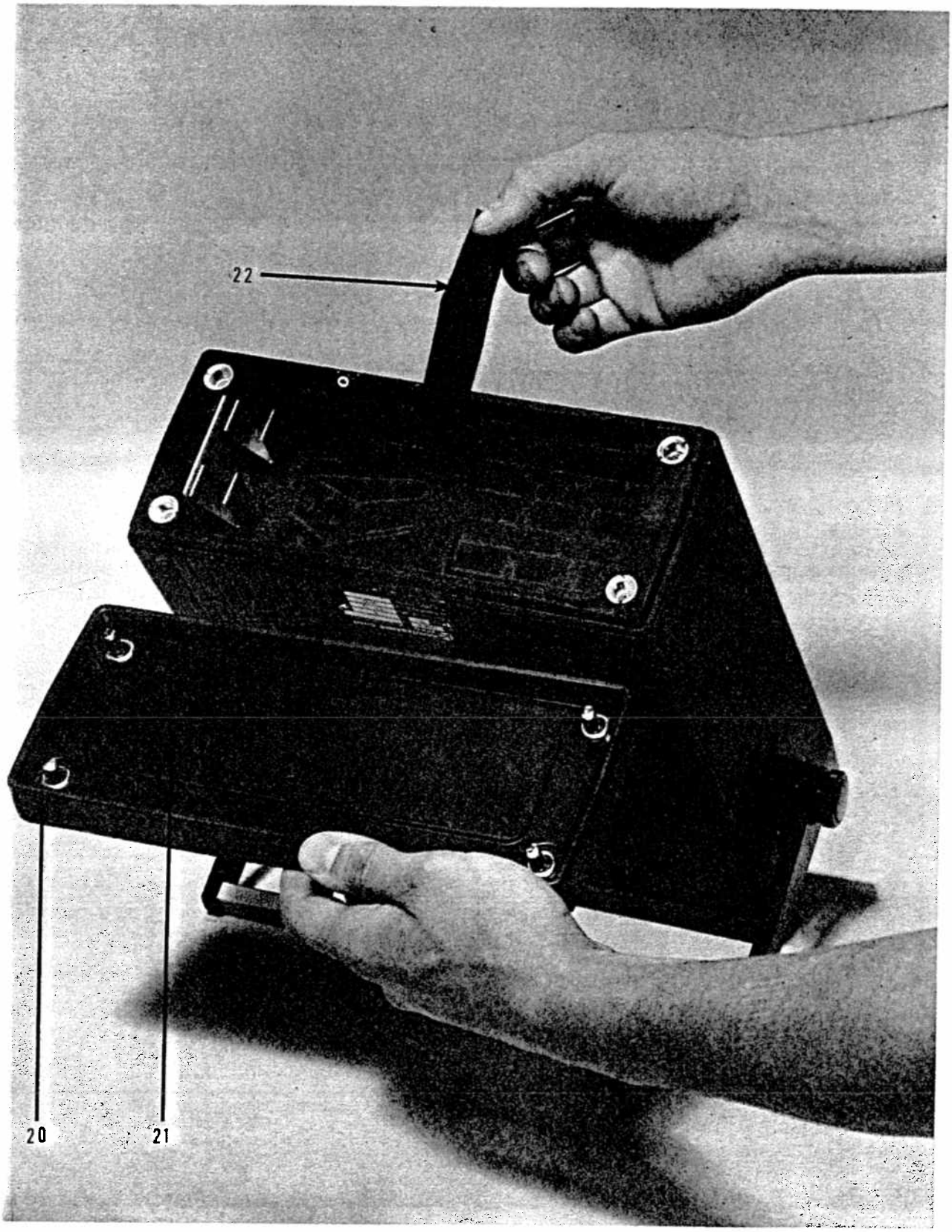


Figure 2-5 Battery Compartment

2-53 Changing the Batteries

2-54 Dry Cells: 1. If you use dry cell batteries (e.g., alkali-manganese), discard them immediately after they have been discharged. Do not recharge dry cells.

2. Use **only** leak-proof dry cells.

2-55 Changing the Batteries in the Instrument (See Figure 2-5)

Note: Disconnect the instrument from the power source before opening.

2-56 Place the instrument face down on a smooth surface.

2-57 Removing:

Press the four pressure fasteners (20) in the cover (21) of the battery compartment to loosen them; remove the cover; pull the withdrawal strap (22); extract the batteries.

2-58 Inserting:

Place the withdrawal strap (22) loosely across the bottom of the battery compartment and allow it to hang free down the side of the housing. Turn the batteries according to the polarity symbols on the bottom of the battery compartment and insert the batteries in the compartment. Insert the two middle batteries last. Lay the end of the withdrawal strap (22) over the batteries. Close the battery cover (21). Press the pressure fasteners (20) until they engage.

2-59 Changing the Batteries in the Charging Frame

2-60 Removing:

Grip the batteries with the thumb and index finger in the cut-outs in the side of the charging frame; lift the batteries upward out of the frame.

2-61 Inserting:

When inserting the NiCad cells (NCA 2-6) match the polarity symbols on the bottom of the charging frame with the polarity symbols on the batteries. (Size "D" cells are used.)

2-62 Changing the Fuse (See Figures 2-6 and 2-7)

Note: Disconnect instrument from power source before opening.

2-63 Open the battery compartment, unscrew back panel; see para. 2-55.

2-64 Unscrew the voltage supply panel (24) and hinge it upwards. Change the fuse (25) on the underside of the voltage supply panel. (0.8A-slow).

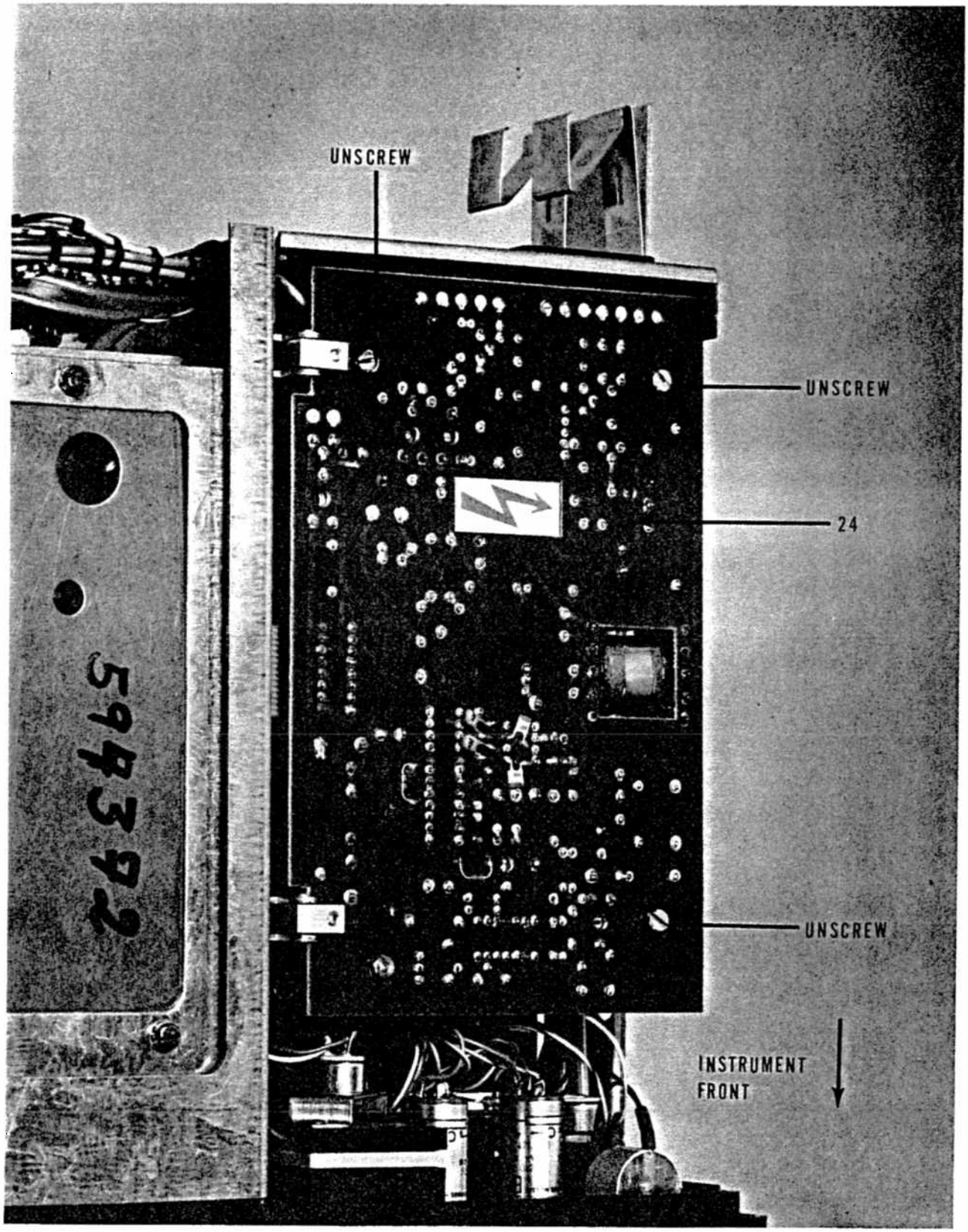


Figure 2-6 Voltage Supply Panel

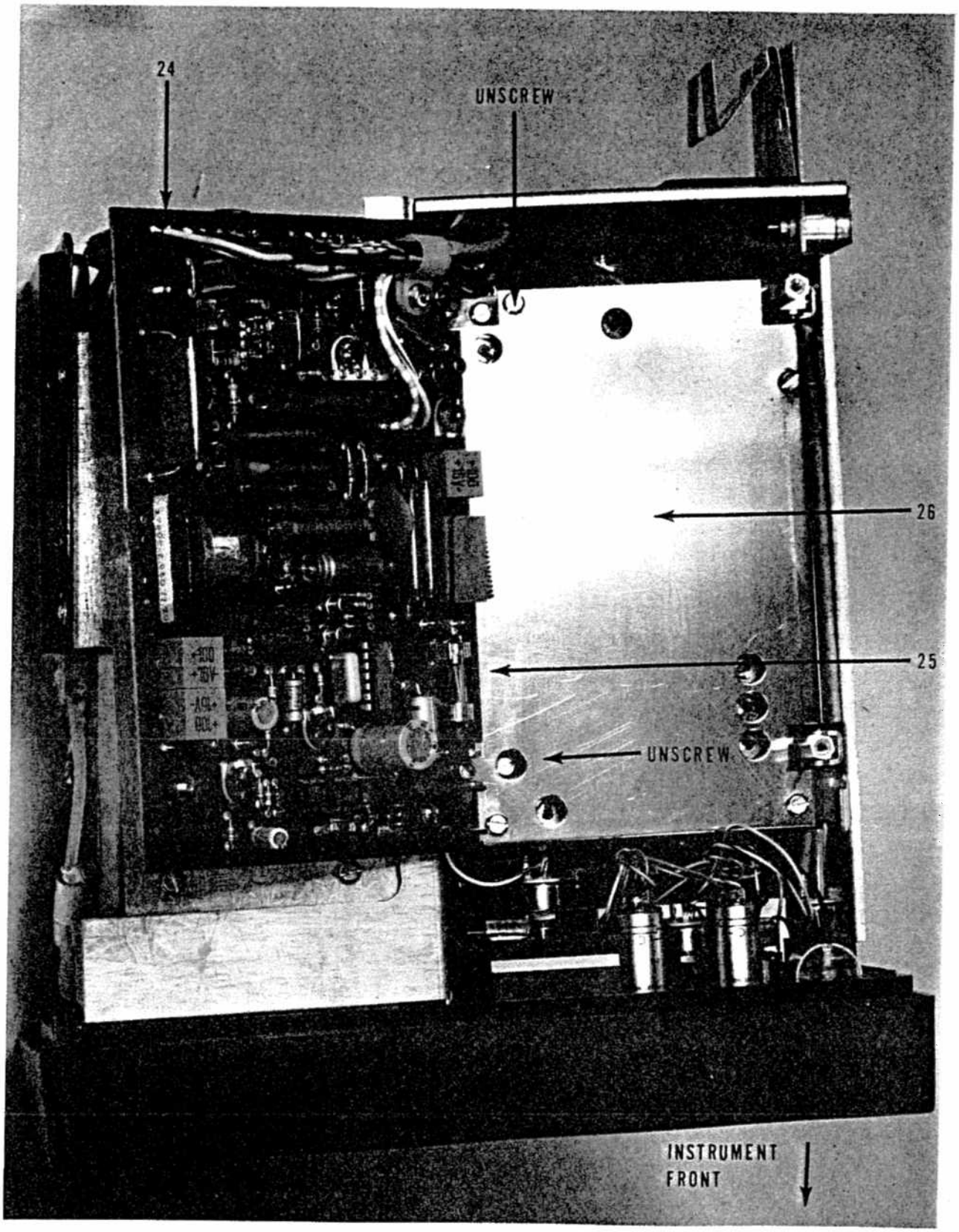


Figure 2-7 Fuse Location

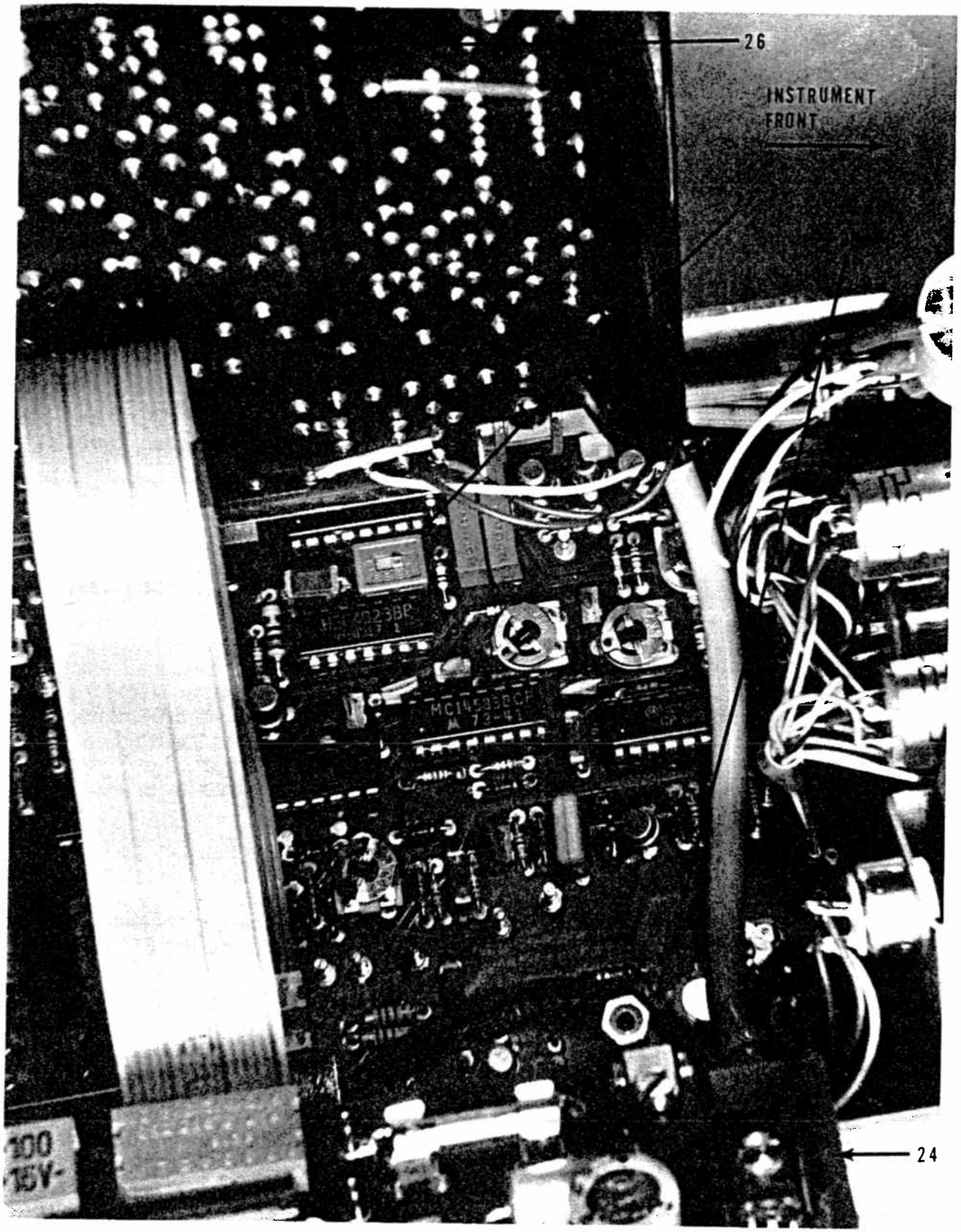


Figure 2-8 Gate Logic Switch Location

2-65 Switch to Anti-coincidence (negative logic gate) See Figure 2-6, 2-7 and 2-8.

Note: Disconnect instrument from power source before opening.

2-66 Open the battery compartment, unscrew back panel; see para. 2-55.

2-67 Unscrew the voltage supply panel (24) and hinge upward; unscrew the amplifier panel (26) and hinge upward; set slide switch (27) on the lower printed wiring card (28) to position 2. See Figure 2-8 for switch location.

2-68 Cleaning of the Instrument Housing

2-69 The housing surface must be made **only damp** (not wet) when cleaning.

2-70 Cleaning substances: water and mild soap should be used. Use of a harsh detergent or other cleaning substance may damage the instrument housing.

2-71 Adjusting the Carrying Handle

2-72 To adjust the position of the carrying handle, rotate each of the two knobs at the base of the handle counterclockwise until the handle is **completely free to move.**

2-73 Move the carrying handle into the appropriate position.

2-74 Rotate each of the two knobs at the base of the carrying handle clockwise to lock the handle in position.

Note: Do not attempt to **force** the carrying handle into a new position as this may cause the handle to break.

2-75 CRT Scale

2-76 The CRT scale can be removed for cleaning or application of any other overlay scale, such as the DGS scales.

2-77 To remove the CRT scale depress the ribbed area of the bezel at the base of the CRT screen. This will cause the top of the scale to pop out for easy removal.

2-78 To replace the CRT scale, insert the bottom of the scale in the slot at the bottom of the screen. Then push the top of the screen towards the CRT until it pops into place.

2-79 Protective Cover

2-80 The USK6 is equipped with a protective cover which is designed to protect the instrument controls and the CRT screen from moisture, dust, etc.

2-81 The cover should be placed firmly over the face of the instrument to protect it while it is being carried or transported.

2-82 It is recommended that the protective cover be placed on the face of the instrument any time the instrument is not in use.

2-83 When the instrument is in use, the cover can be stowed on the back of the instrument. This position provides additional impact protection for the battery compartment.

2-84 Gate Alarm Earphone

2-85 An earphone is available for circumstances when an audible as well as a visual gate alarm is desired. Plug the earphone into the multi-purpose connector (6).

2-86 Be careful to align the pins correctly when plugging the earphone into the multi-purpose connector.

2-87 Carrying Strap

2-88 In addition to the carrying handle, a carrying strap is provided for carrying the instrument long distances, or when both hands must be free for climbing, etc.

2-89 The carrying strap is attached to the holes in the tabs at the base of the carrying handle.

2-90 Lightshield

2-91 A lightshield is available to improve CRT viewing under bright ambient light conditions. Clip the shield on the instrument housing so the shield frames the CRT screen.

2-92 Coarse Attenuator (Plug-In)

2-93 The high sensitivity of the USK6 produces substantial available gain for material penetration and display of small and/or distant reflectors. In less challenging tests, when larger reflectors close to the test surface must have their echoes displayed at less than 100% screen height, a Coarse Attenuator is available for gain reduction. The Coarse Attenuator provides roughly 20 dB of gain reduction, with the exact amount of gain reduction depending upon probe frequency. To use the Coarse Attenuator, insert it in series with the transducer, that is, connect the Coarse Attenuator between the instrument TRANSMIT connector and the cable to which the transducer is attached.