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LOS ALAMOS NATIONAL LABORATORY
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DESIGN AND CONSTRUCTION OF THE "PEE WEE"
PORTABLE PROPORTIONAL ALPHA SURVEY METER

Work Done By:

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Report Written By:J. ^{John}H. Larkins

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Design and Construction of the "Pee Wee"
Portable Proportional Alpha Survey Meter

DESIGN:

The "Pee Wee" portable proportional alpha survey meter uses an electronic circuit which has proved to be quite stable and reliable in the Mark I, Model 41 portable survey meter (ref. CP-2854). The "Pee Wee" was designed for use in Los Alamos Laboratories and to eliminate the objectionable features of mechanical design of the Mark I, Model 41 instrument.

The "Pee Wee" is housed in a single aluminum box 5 3/8" x 8" x 11 1/2" and weighs approximately 15 pounds. The box has a door at each end to provide easy access to the elements for servicing. The meter is mounted in the top at one end and the controls grouped around it so that those most frequently used -- the range switch and reset switch -- are near the handle and may be operated with one hand while carrying the instrument.

Two unique features of the "Pee Wee" are the removable amplifier unit and input circuit. The tubes and associated resistors and condensers are connected to brass lugs mounted through a bakelite panel. Along each side of the panel are six banana plugs. Inside the box at one end are two strips of bakelite in which are mounted jacks to correspond with the plugs in the panel. Thus a faulty amplifier unit may be completely removed from the instrument and replaced in a matter of seconds with one that is known to be in good working order. The input circuit, consisting of the cable connector, input condenser and resistor, and de-



coupling condenser and resistor, is similarly easy to remove for replacement or cleaning. It may be removed by pulling the positive plug from the high voltage battery, unsoldering one very easily accessible connection and loosening two screws in the top of the case.

The parts attached to the case are those which are least likely to require attention -- the meter, pulse height selector potentiometer, and the switches. The batteries are all contained within the case and may be reached for replacement by opening the door on the end opposite the meter and amplifier. However, to check the voltages of the batteries it is only necessary to open the door on the amplifier end. The components are so arranged that almost any one can be replaced without disturbing the connections of any other part. The arrangement likewise facilitates trouble shooting, since any point on the circuit may be reached easily for testing.

A canvas bag with a detachable shoulder strap and a pocket for probes has been designed for carrying the instrument and to protect it from contamination. In order to minimize probe contamination, the probe pocket is attached to the bag with snap fasteners so that it may be removed and laundered or replaced.

CONSTRUCTION OF BOX:

The box (Drawing #4) is made of 1/16" aluminum with a 3/8" bakelite bottom. The doors are each hinged upon two #6 flat head screws at the lower corners. The holes for the screws are tapped just deep enough that the screws will fit tightly and still allow sufficient freedom for the doors to open and close

easily. The two strips for the banana jacks are located $1\frac{1}{2}$ " inside the end of the box. They are held in place by three #6 flat head screws through the sides of the box into tapped holes in the bakelite. These holes should be spaced so as to clear the jacks. After the strips are in place the $1/4$ " holes for the jacks are drilled, using a jig (Drawing 2, Fig. 1) to locate them accurately. This eliminates any possible errors due to variations in box dimensions. Across the bottom of the box is fastened a strip of bakelite about $5/16$ " x $3/8$ " x $5\frac{1}{4}$ " at such a point that the high voltage batteries will clear the door by about $1/4$ ". In the top of the box the T-shaped battery spacer (Drawing ILY-3002 C3) is fastened with three #6 flat head screws. The handles which have been used have the holes spaced so that one of the handle screws enters the battery spacer. One of the handle screws which enters the battery compartment must have a hole tapped in the aluminum as there is not room enough for a nut. The door on the battery end is held closed by a #6 flat head screw which enters a tapped hole in the end of the battery spacer. The door on the amplifier end is held by a rotary latch (Drawing 4). The screw for this latch is tight in the bakelite, and the hole in the aluminum is countersink just enough to allow it to turn. Pieces of sponge rubber are cemented to the door to hold the batteries in place and to provide insulation for the B battery connectors.

WIRING THE BOX:

In wiring the box (see Drawing 3) a jig made to correspond to the dimensions of the box may be used very con-

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veniently. With the range switch, on-off switch and pulse height selector potentiometer in place in the jig, the wires can be connected to the controls, bent, cut, and stripped; so that when the controls are installed in the case it is only necessary to solder the wires to the lugs of the banana jacks. Since the lead to the phone jack must run near the input circuit, it should be a shielded wire. This is convenient also because the shield can be grounded to the head phone jack and used as a ground for the amplifier panel by connecting the other end of the shield to the proper banana jack.

INPUT CIRCUIT

The input circuit is mounted upon the assembly shown in drawing ILY-30002 G2. The 50 mmf condenser is mounted upon 3/16" - high brass standoffs and held in place by two #6 screws through the polystyrene panel. A solder lug under the head of one of the screws provides a place to connect a ground wire, the other end of which is soldered to the brass plate. Other connections are made to solder lugs screwed to the polystyrene. Connections to the ungrounded side of the 50 mmf condenser are made to a solder lug placed between the condenser terminal and standoff, so that the condenser may be removed without unsoldering any connections. The 40 mmf condenser has wire leads and must be soldered in place. Since the terminal of the cable connector fits rather loosely in the insulator, it might be well to bend the wire leading to it into a one-or two-turn helix in order to allow the terminal to move more freely and also to avoid placing a strain on the soldered joints. The pig tail of the 5 M resistor may be used to make this connection.

AMPLIFIER PANEL:

The amplifier panel is constructed as shown in Drawing 1. The material should be cut a little wide so that it may be trimmed after the panel is assembled. A drill jig (Drawing 2, Fig. 3) is used to locate starting holes for a 1/16" end mill which is used to mill out slots for the lugs. The slots should be milled long enough for the lugs to enter with reasonable ease. The two halves of the panel are drilled and milled together to insure alignment of the holes. In case the material should be warped, the halves should be matched so that when pulled together they will be flat. The large ends of the lugs are then inserted in the holes in the front half of the panel, taking care that the offsets are all in the same direction. Then starting at one edge, the other ends of the lugs may be worked into place in the back half of the panel. The panel is then pressed together and the handles fastened on with two #4 flat head screws through the panel into holes tapped in the handles. These screws should be located at the centers of the two outside finger holes so they will not interfere with the banana plugs. Using a drill jig (Drawing 2, Fig. 2) holes are then drilled and tapped for the banana plugs. Banana plugs should be chosen which have flexible springs and an adequate length of threads. The panel is wired as shown in Drawing 3.

COMPONENTS:

All resistors are $\frac{1}{2}$ watt Allen-Bradley or equivalent. Dumont .1 mfd. 150V condensers are used because of their small size. A Solar midget electrolytic condenser (2 mfd., 150V) is used for decoupling in the plate supply to the first tube, and

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[REDACTED]

a 200 mfd., 1.5 V condenser of similar size is used for integrating in the meter circuit. The push button reset switch should not be of the positive action type because the vibration may tend to introduce spurious counts. The rotary on-off switch is a Mallory No. 3143J, four circuit, three position switch. Since these switches are not designed for high voltage operation, the high voltage is switched on the negative or grounded side. However, these switches seem to stand the voltage satisfactorily. Previously, Isolantite-insulated switches were used in the high side, and some trouble from leakage was encountered due to dust and moisture. With the switch on the ground side, when the instrument is turned on there is no chance for leakage. The extreme right hand position is used for "On", and the other two outside terminals may be clipped off. The high voltage circuit is grounded by soldering the outside terminal to the case of the switch. The negative high voltage battery lead is connected to the inside terminal of the switch.

COUNTING CHARACTERISTICS:

Three different types of alpha probes can be used with the "Pee Wee" (see photographs No. 13 and No. 14). Due to the design of the 4 x 6 probe, it may be necessary to increase the sensitivity of the instrument somewhat above that required when using a pencil probe. The Weston 20 microampere meter is calibrated 0-20. The low range (0-2000 counts/minute) readings may be obtained by multiplying by 100 and the high

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range (0-20,000 counts/minute) by multiplying by 1000. Generally, the calibration of the two ranges is sufficiently close; however, due to capacity tolerance of the coupling condensers in the trigger circuit, it may be found necessary in some instruments to adjust the pulse height selector differently for the two ranges. The scales are linear within the accuracy with which the meter can be read. The instrument is insensitive to beta and gamma radiation except in the case of very high values. The signal from beta or gamma radiation is of considerably lower amplitude than the alpha pulses and will not ordinarily be able to trigger the circuit. However, it may be heard faintly in the headphones.

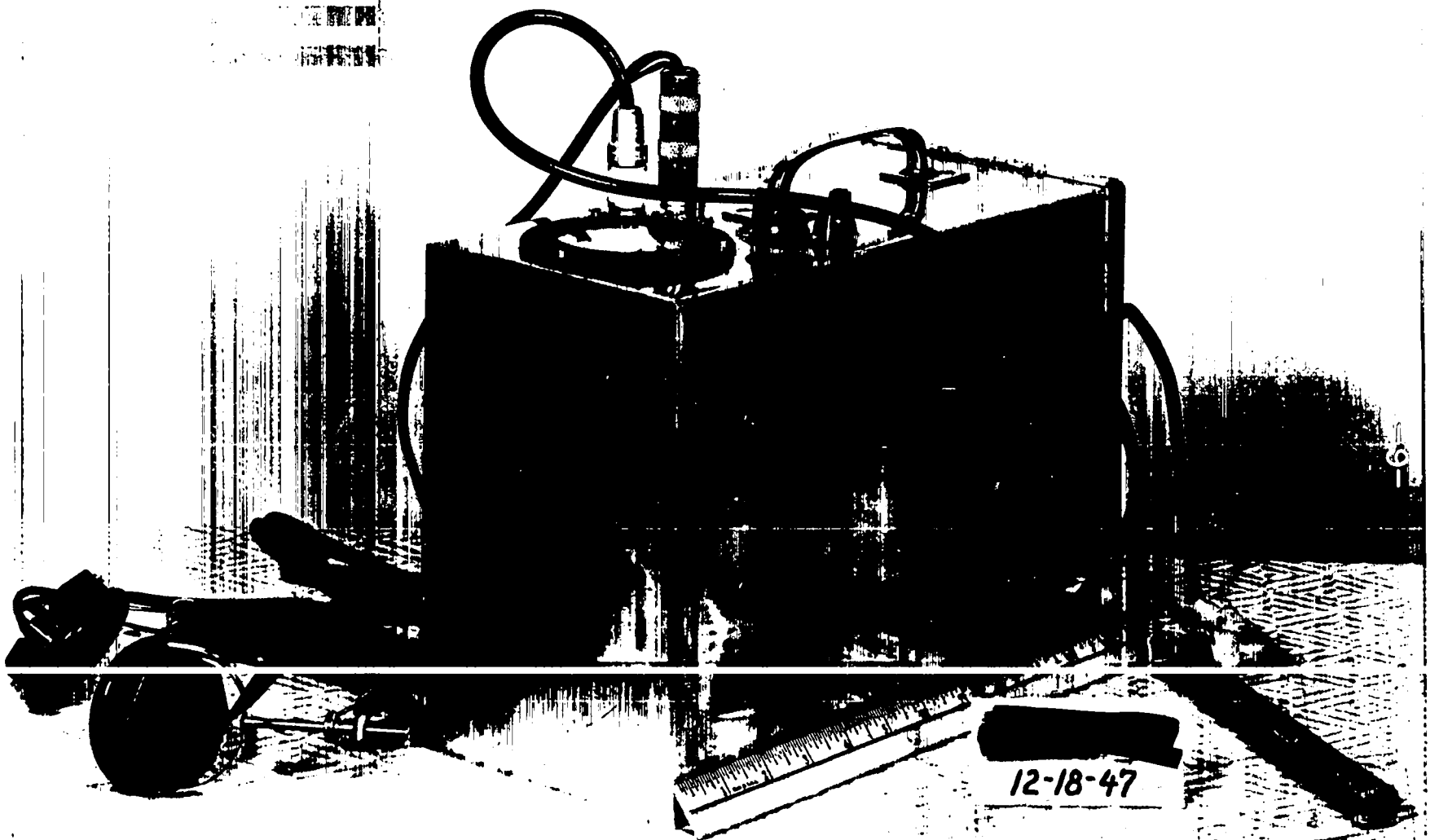
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Photographs

1. General view of instrument with headphones and pencil probe attached.
2. View of top showing arrangement of controls, etc.
3. Same without probe and headphones.
4. Amplifier end with amplifier panel in place.
5. Amplifier end with amplifier panel removed, showing input circuit in place and high voltage battery connections.
6. Front of amplifier panel.
7. Back of amplifier panel.
8. General view of amplifier panel showing handles and banana plugs.
9. Input circuit showing location of cable connector and tapped holes for attaching to case.
10. Input circuit showing arrangement of condensers, resistors, and positive high voltage lead.
11. Battery end with A and B batteries in place.
12. Same with A and B batteries removed.
- 13 & 14. Types of probes which may be used with instrument.

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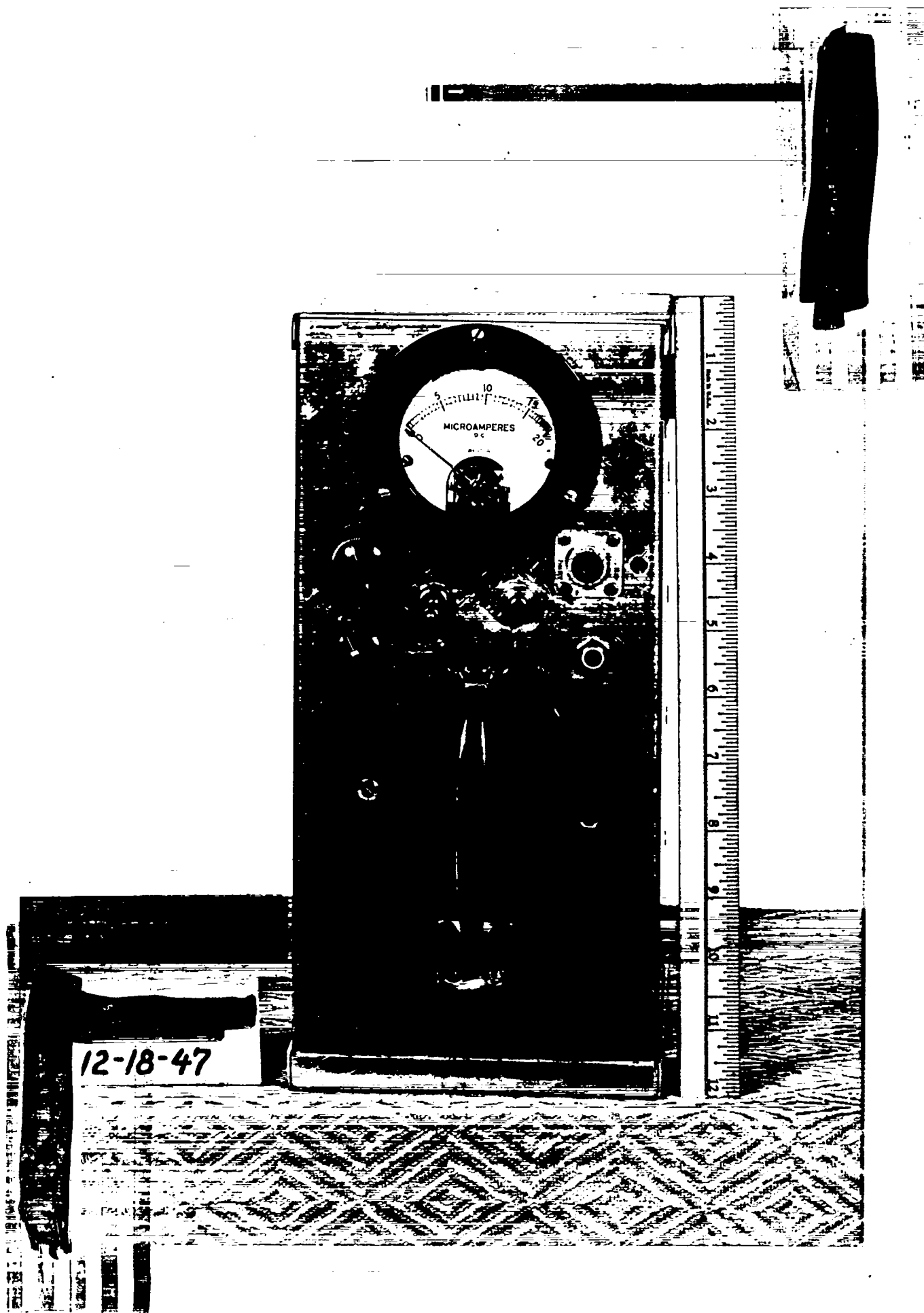
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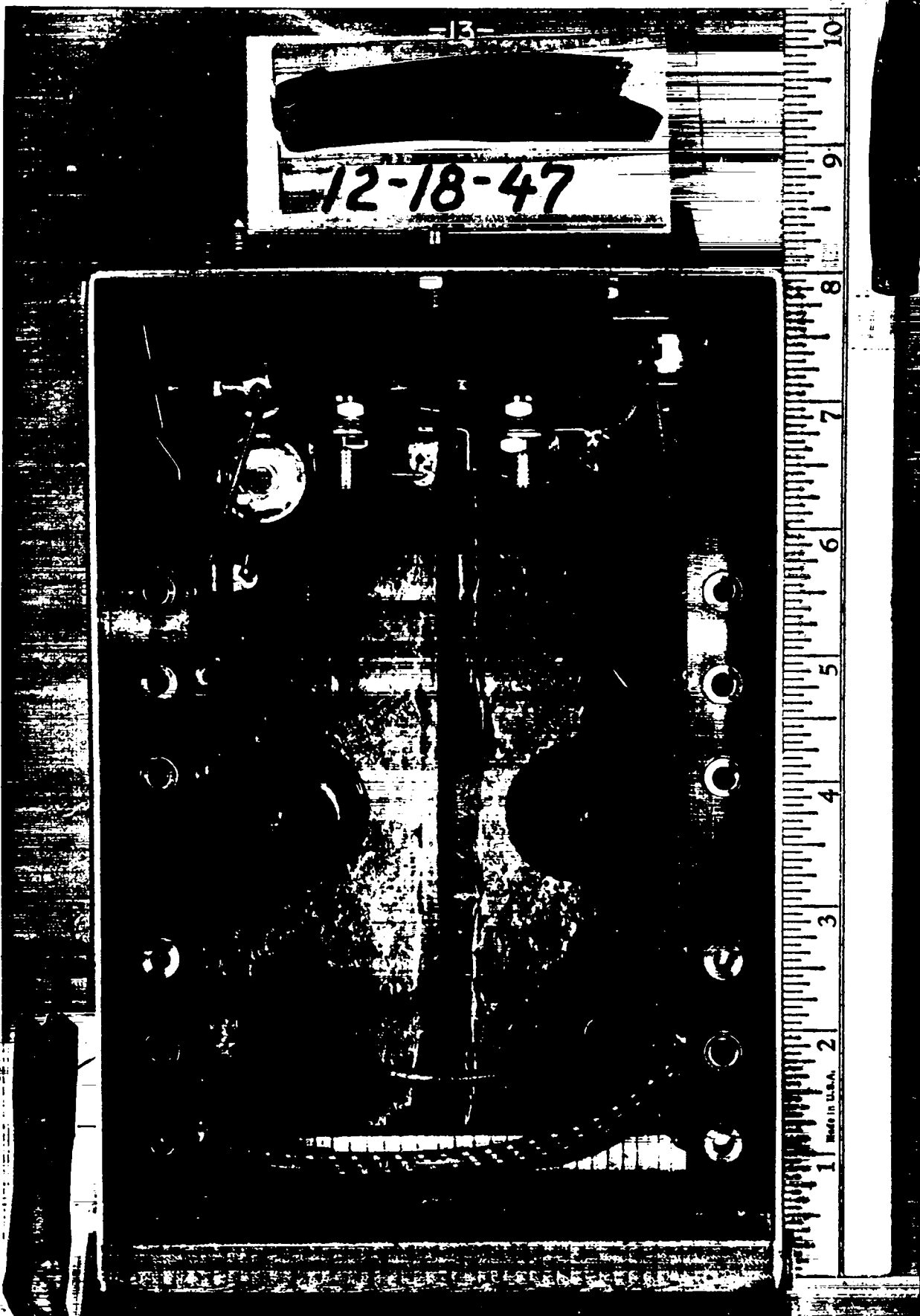


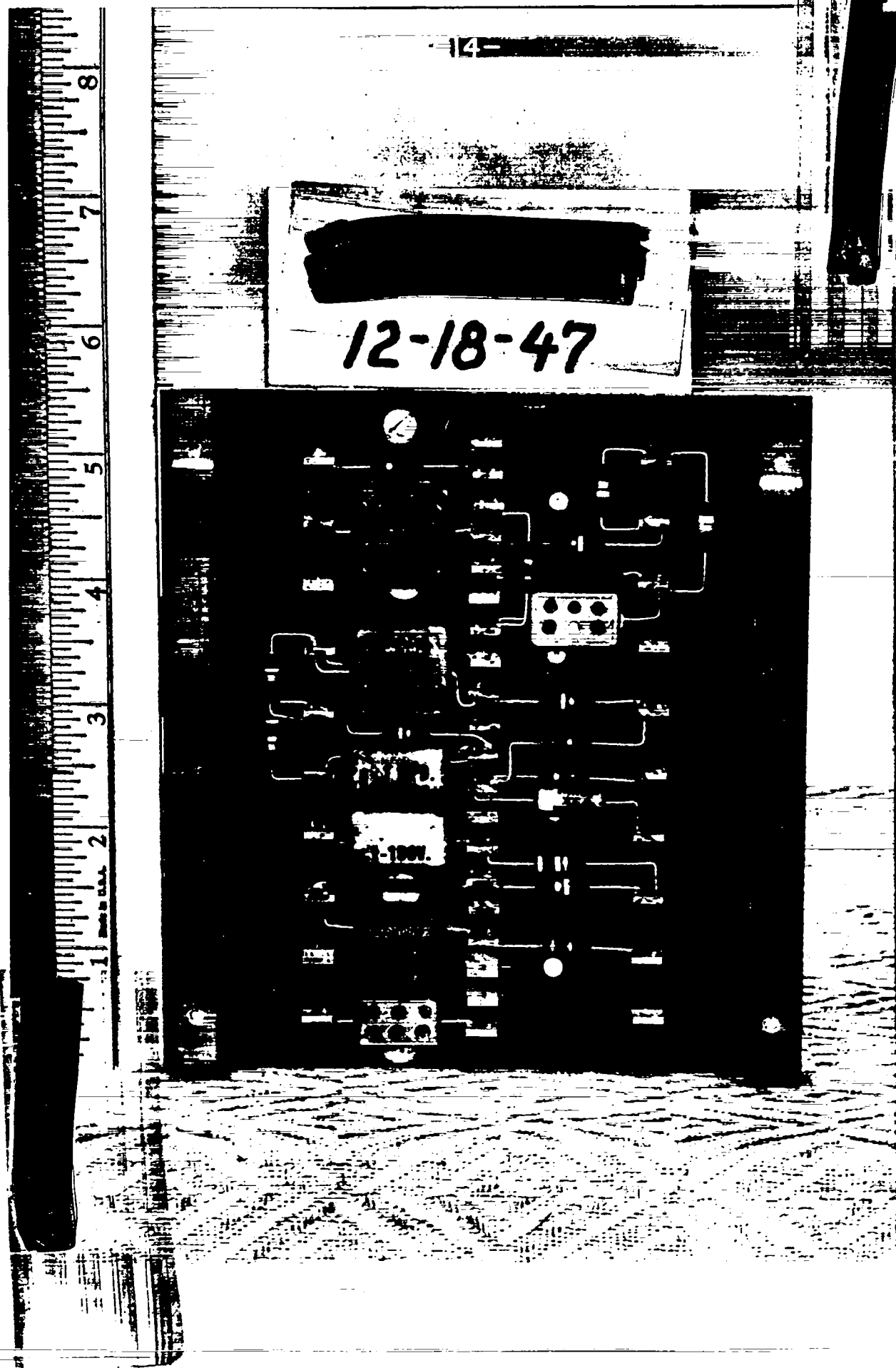
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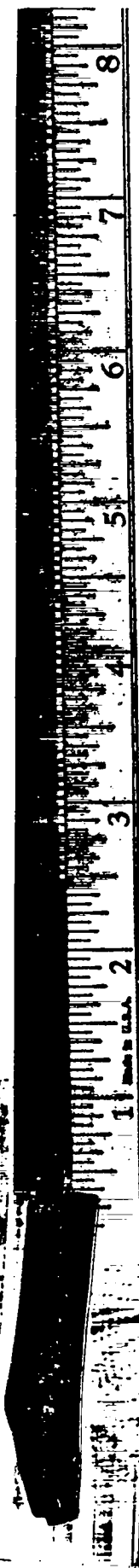
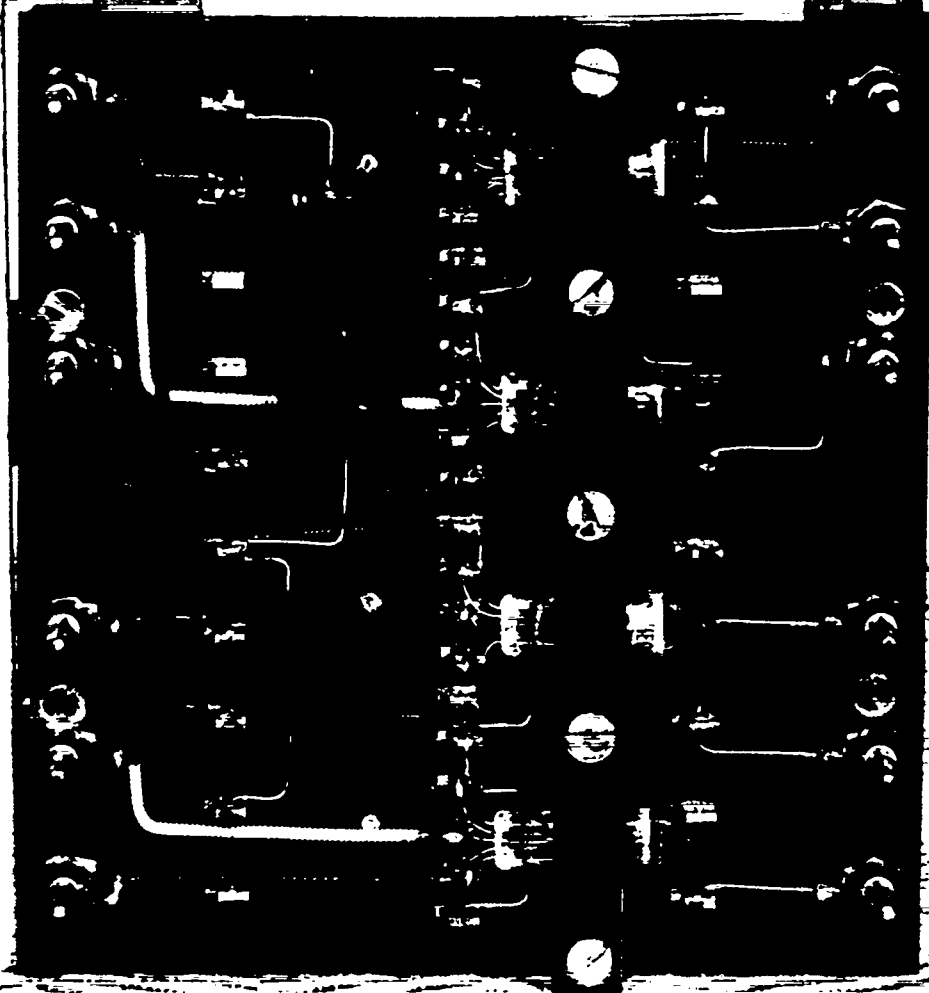




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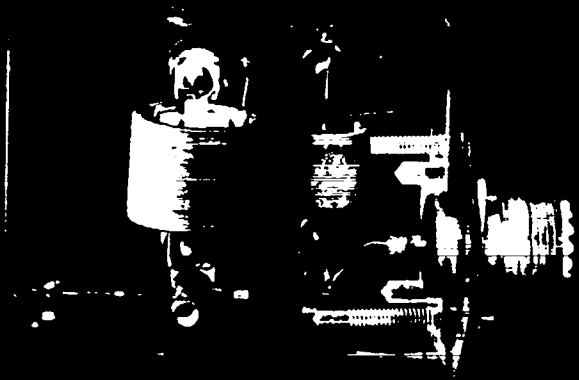


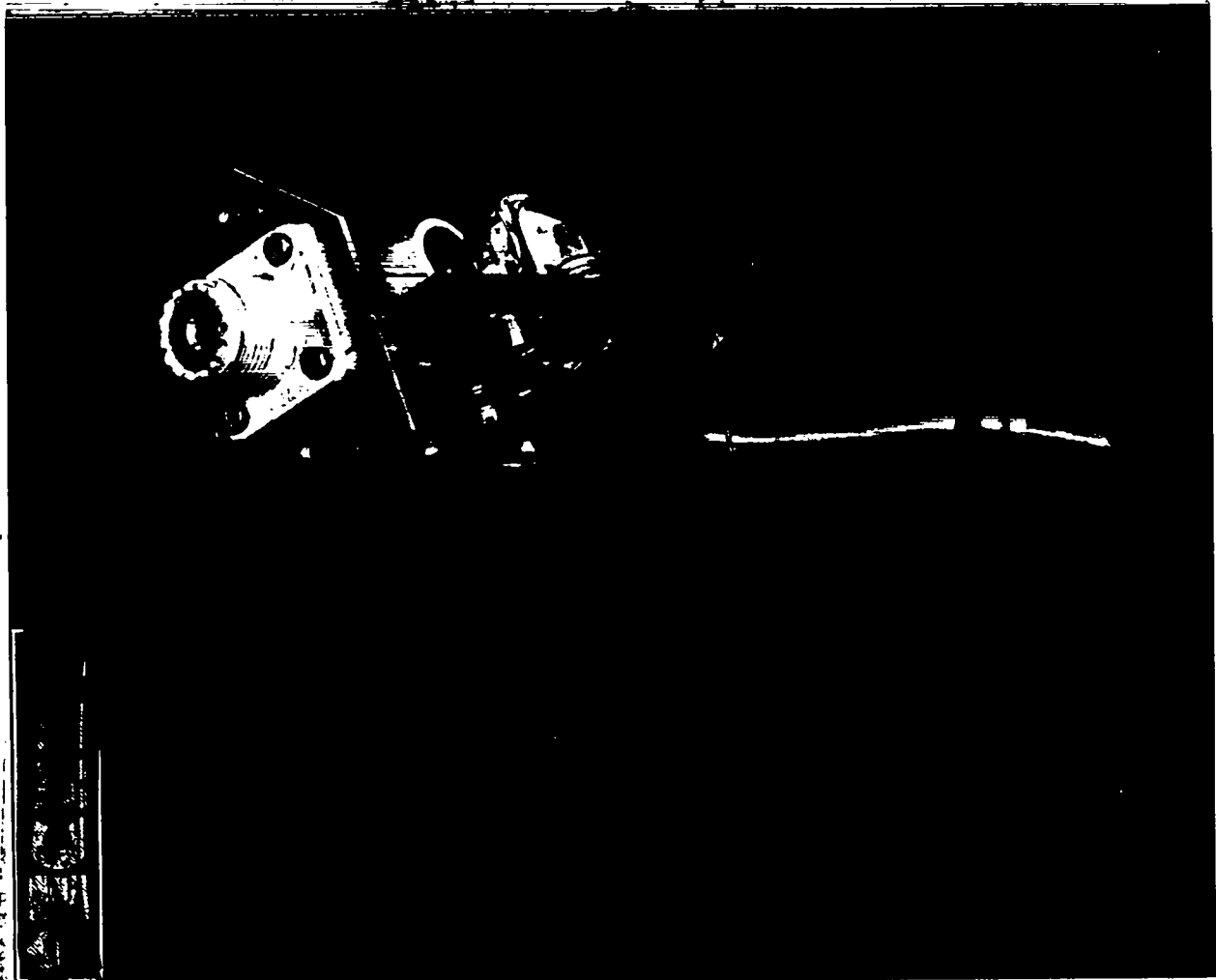
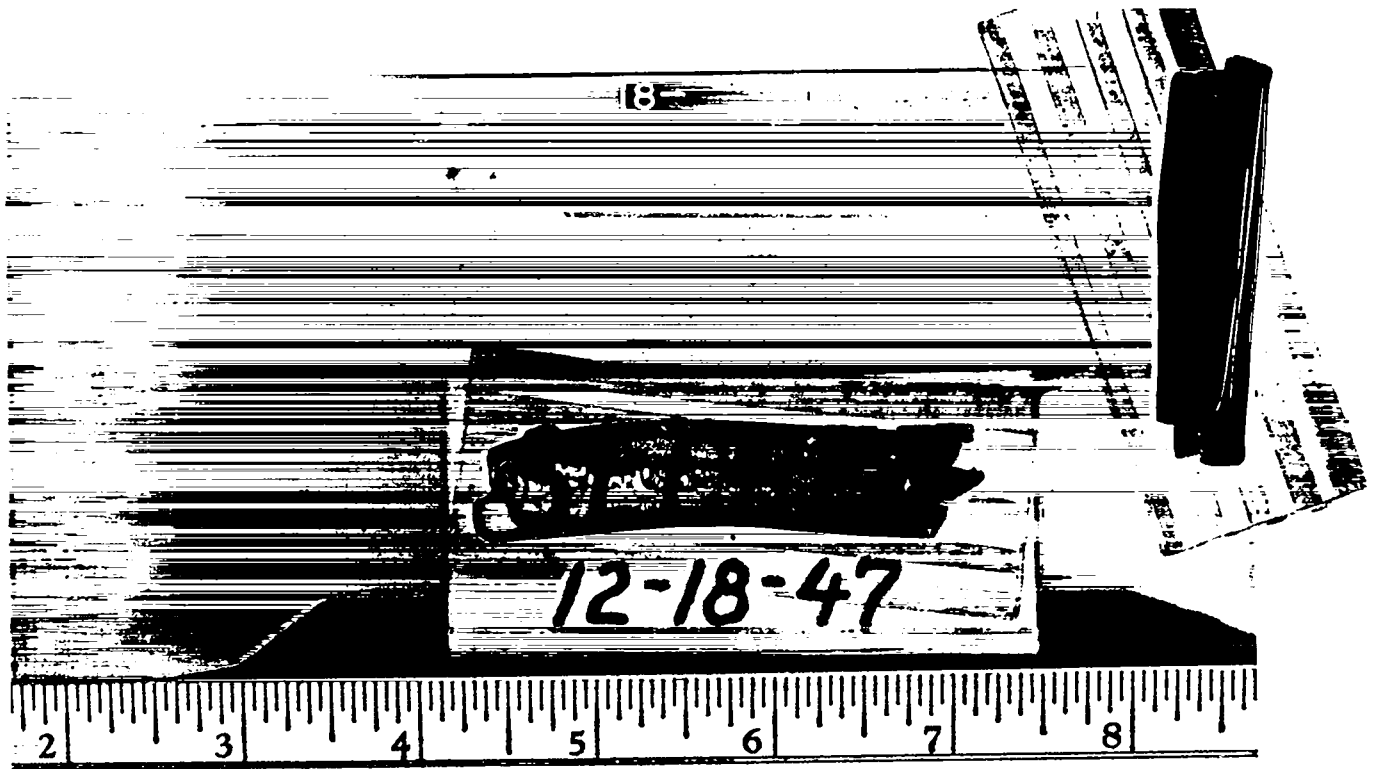
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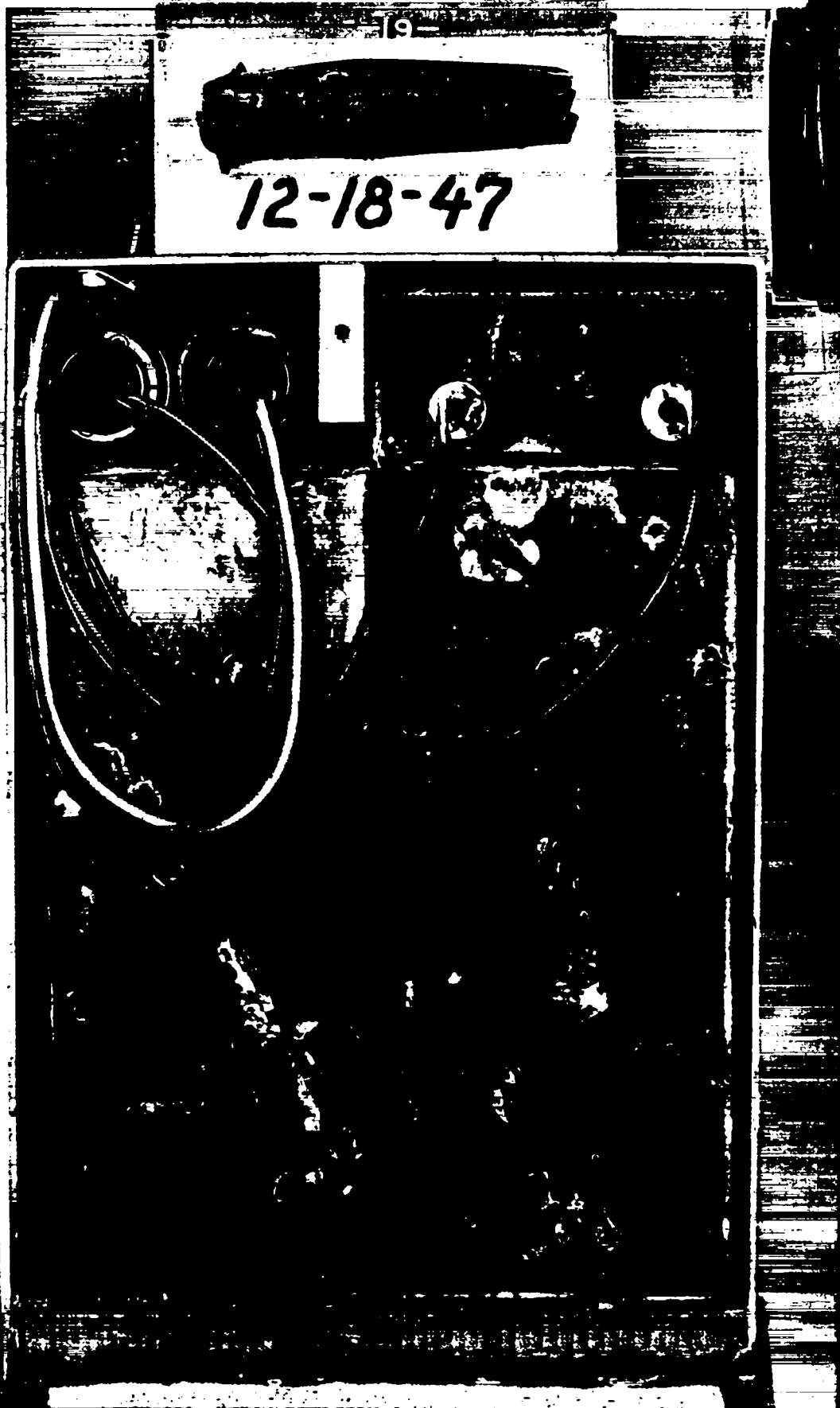
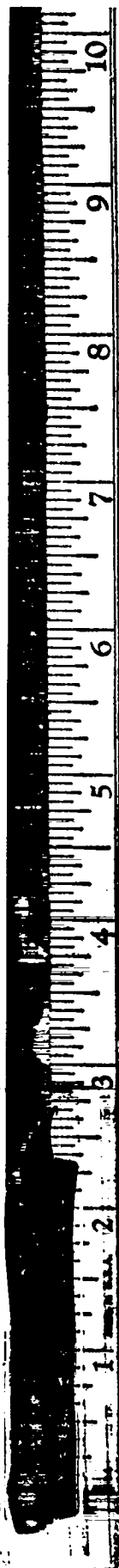


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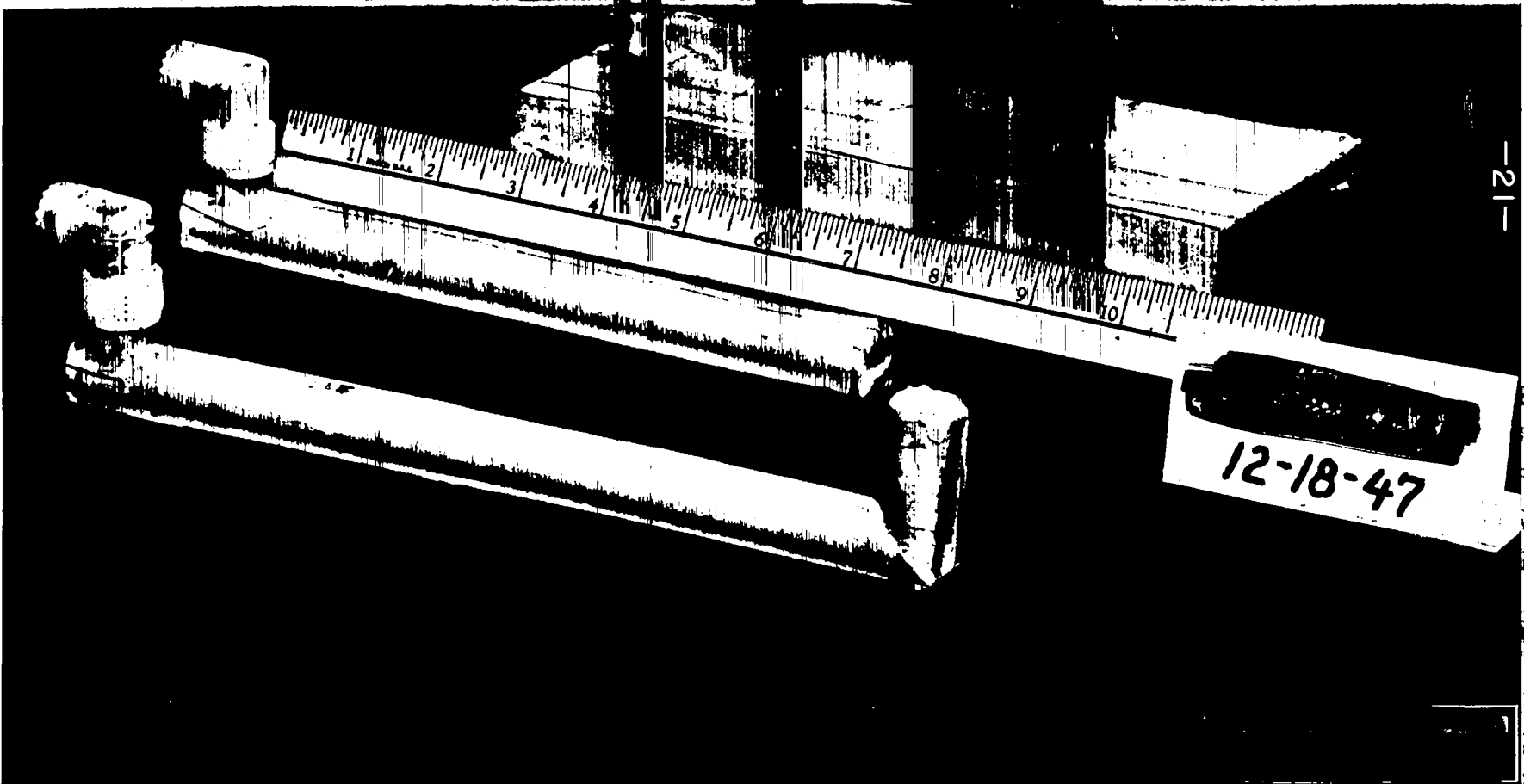




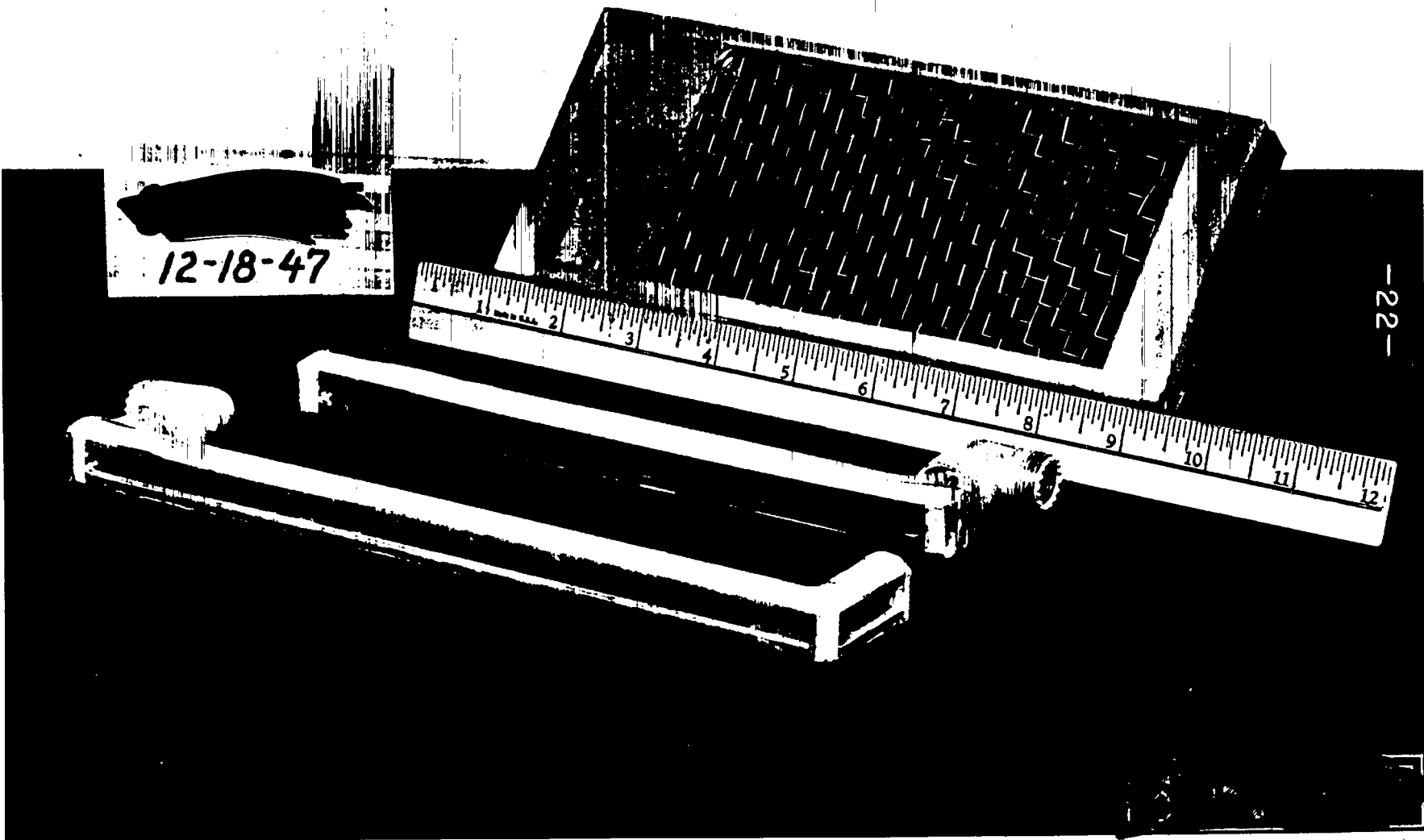




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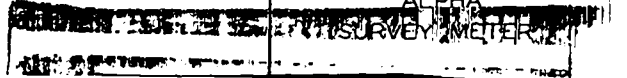


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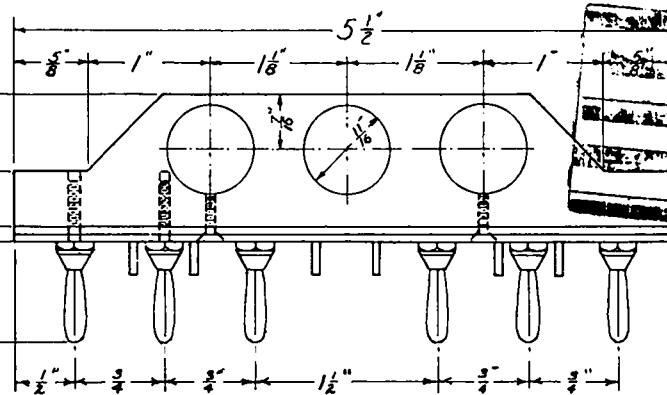
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1. Survey Meter

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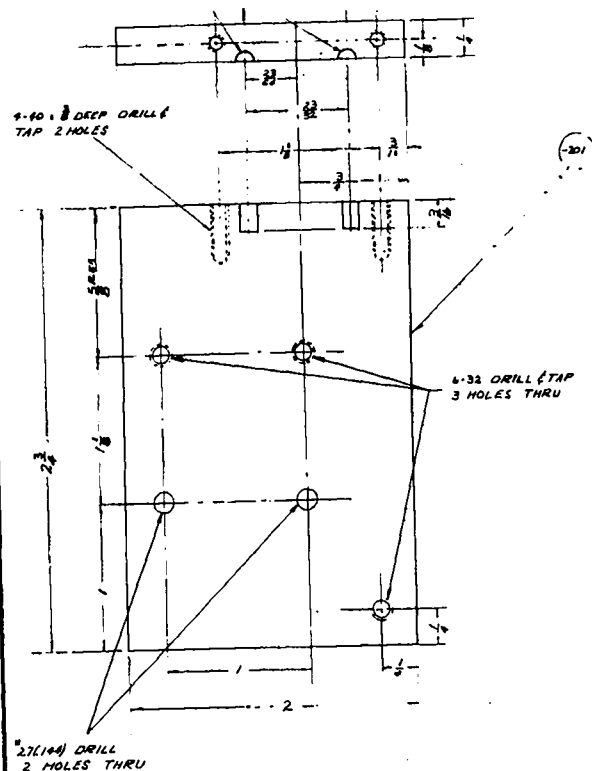


P.E.E. W.F.F.	
AMPLIFIER PANEL	
CMR - 12	
INSTRUMENT SECTION	
DRAWN BY J.E.C.	APPROVED H.C.
DATE MAR 1, 48	SCALE 1" = 1"
DWG. NO. 1	

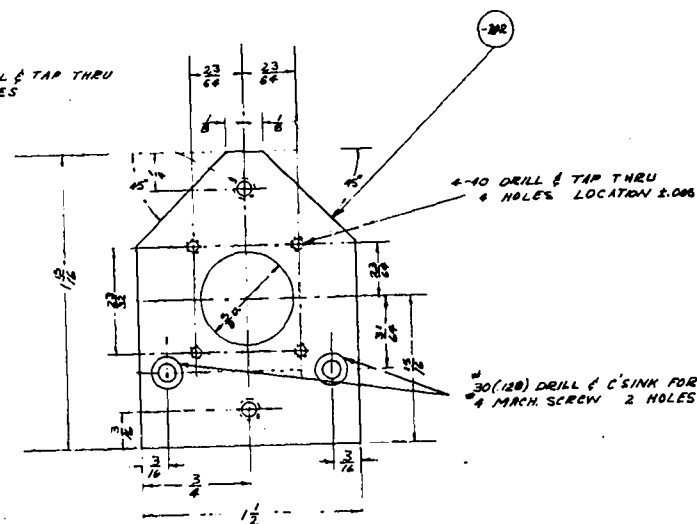
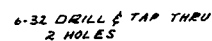
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NET NO.	QTY	FOR	DESCRIPTION
-201	1	ASSY	1 TK POLYSTYRENE
-202	1	ASSY	1 TK SHEET BRASS

76 RAD. MATH
2 PLACES.



NOTE:- DO NOT REMOVE
PAPER BACKING FROM POLYSTYRENE.



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3			
2			
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REVISION	PT. NO.	DATE	INITIAL

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CASE STUDY: CRYSTAL

MUNTER - PEWEE

(PARTS ONLY)

---BRINKMAN

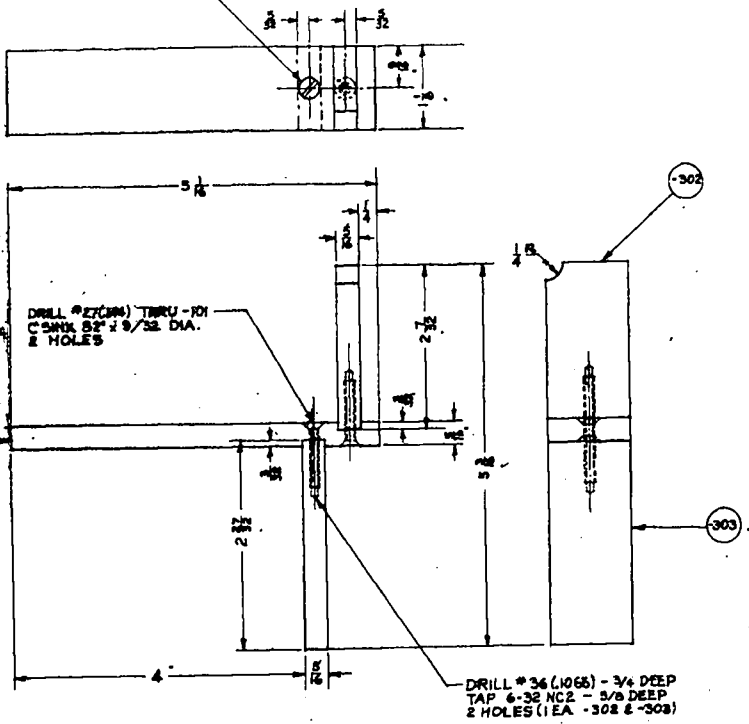
DATE DEC. 29, 1947 NO. 2-1

REPORT No. 11Y-30002 C.

1-20

SIZE OF ASSY			
PART NO.	QUANTITY	FOR	DESCRIPTION
-300	1	ASSY	BATTERY SUPPORT
-301	1	-300	BAKELITE (CLOTH BASE, FINE WEAVE)
-302	1	-300	"
-303	1	-300	"
-	2	-300	MACH SCR - FLT. HD. - #6-32 x 1/4 LG.

SCR - FLT. HD. MACH.
6-32 x 3/4 - 2 REQD.



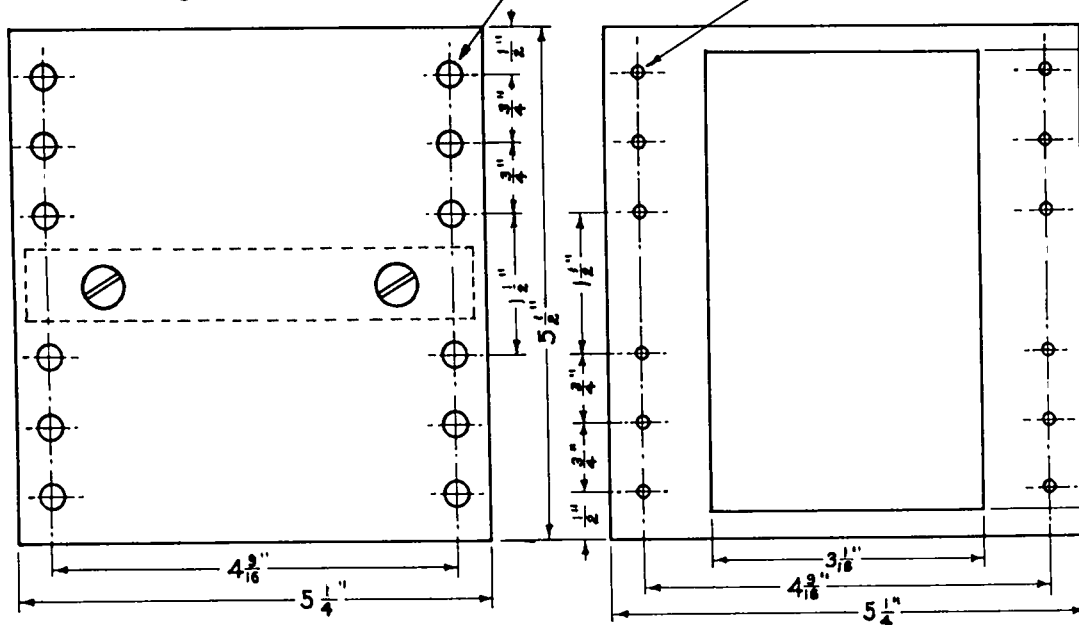
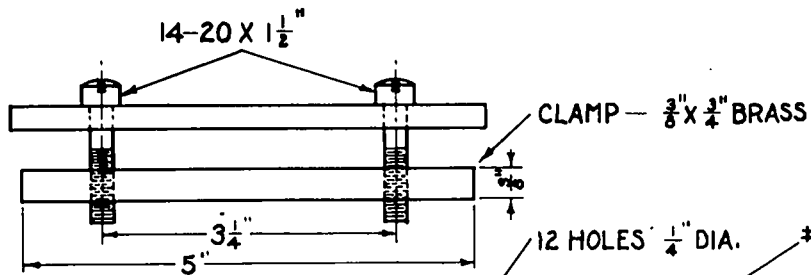


FIG. 1

FIG. 2

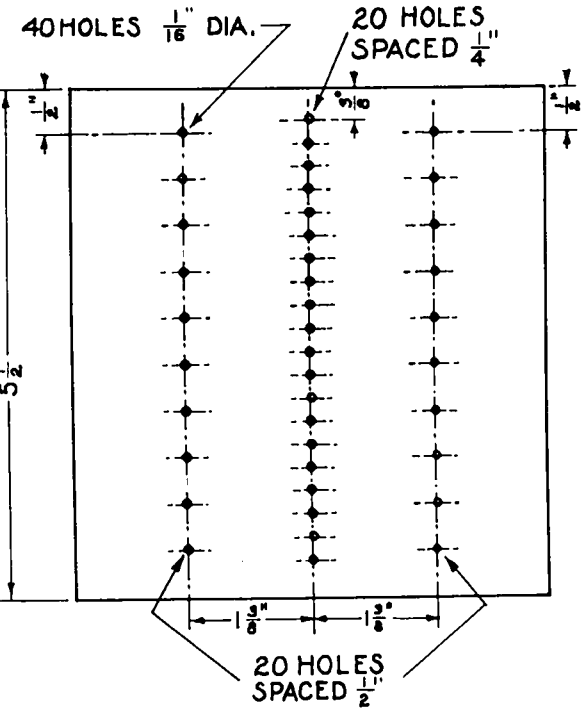


FIG. 3

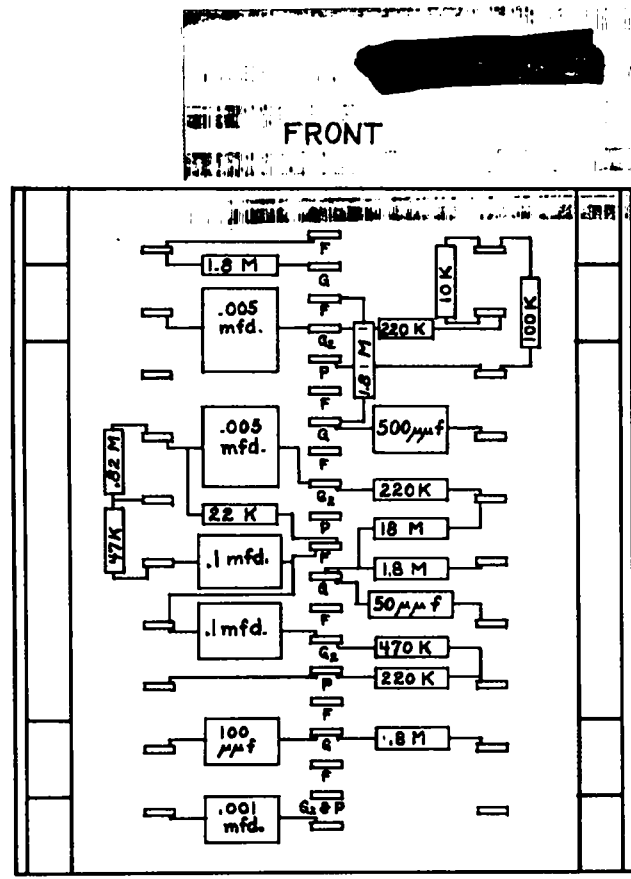
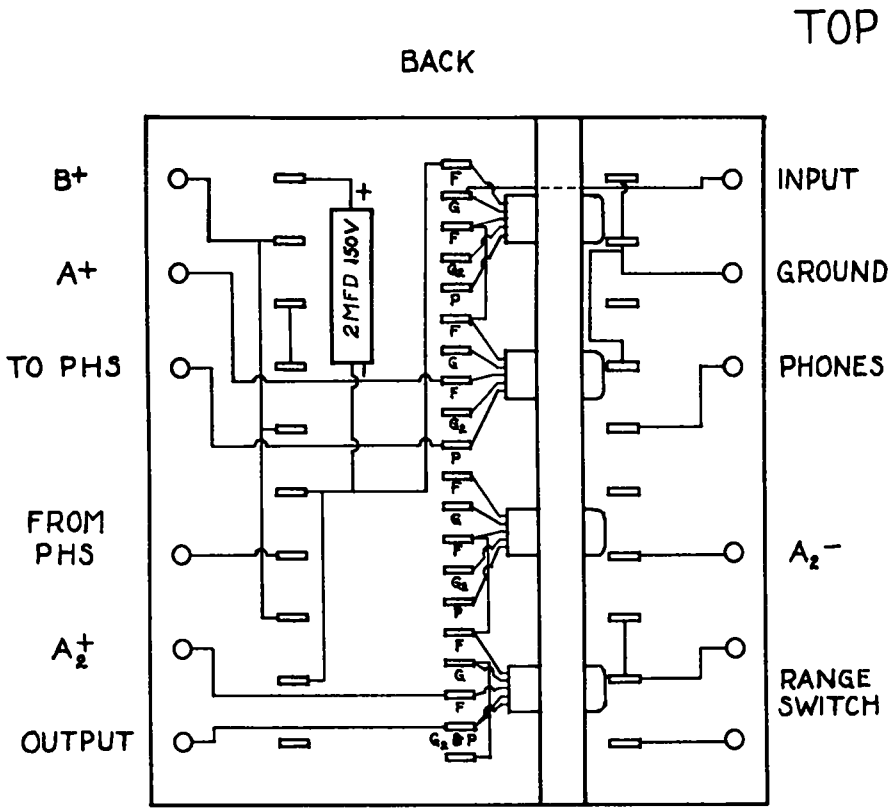
NOTE:
FIG. 1 AND 2 — LOCATION OF HOLES WITHIN $\pm .002$ "
MATERIAL — 1/4" SHEET STEEL

DRILL JIGS

CMR - 12 INSTRUMENT SECTION	
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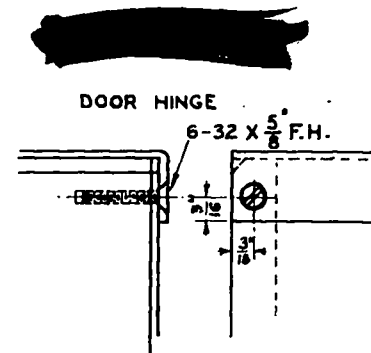
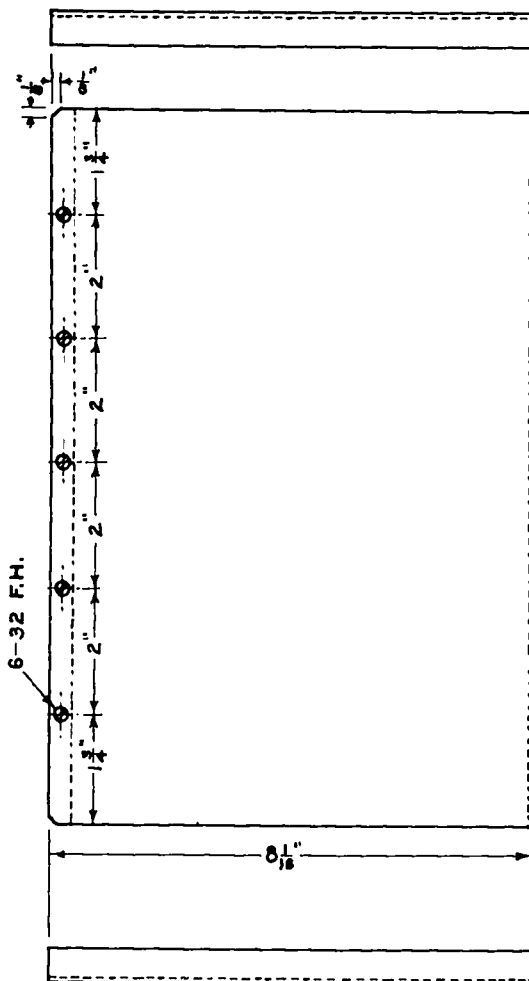
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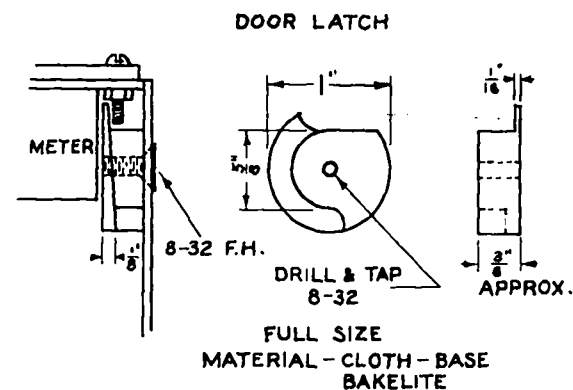


AMPLIFIER PANEL WIRING	
CMR-12	
INSTRUMENT SECTION	
DRAWN BY: J.L.	APPROVED <i>NEB</i>
DATE: APR. 26, 48	SCALE 1"=1"
DRWG. No. 3	

MATERIAL: $\frac{1}{16}$ " POLISHED ALUMINUM
BOTTOM — $\frac{3}{8}$ " CLOTH-BASE BAKELITE



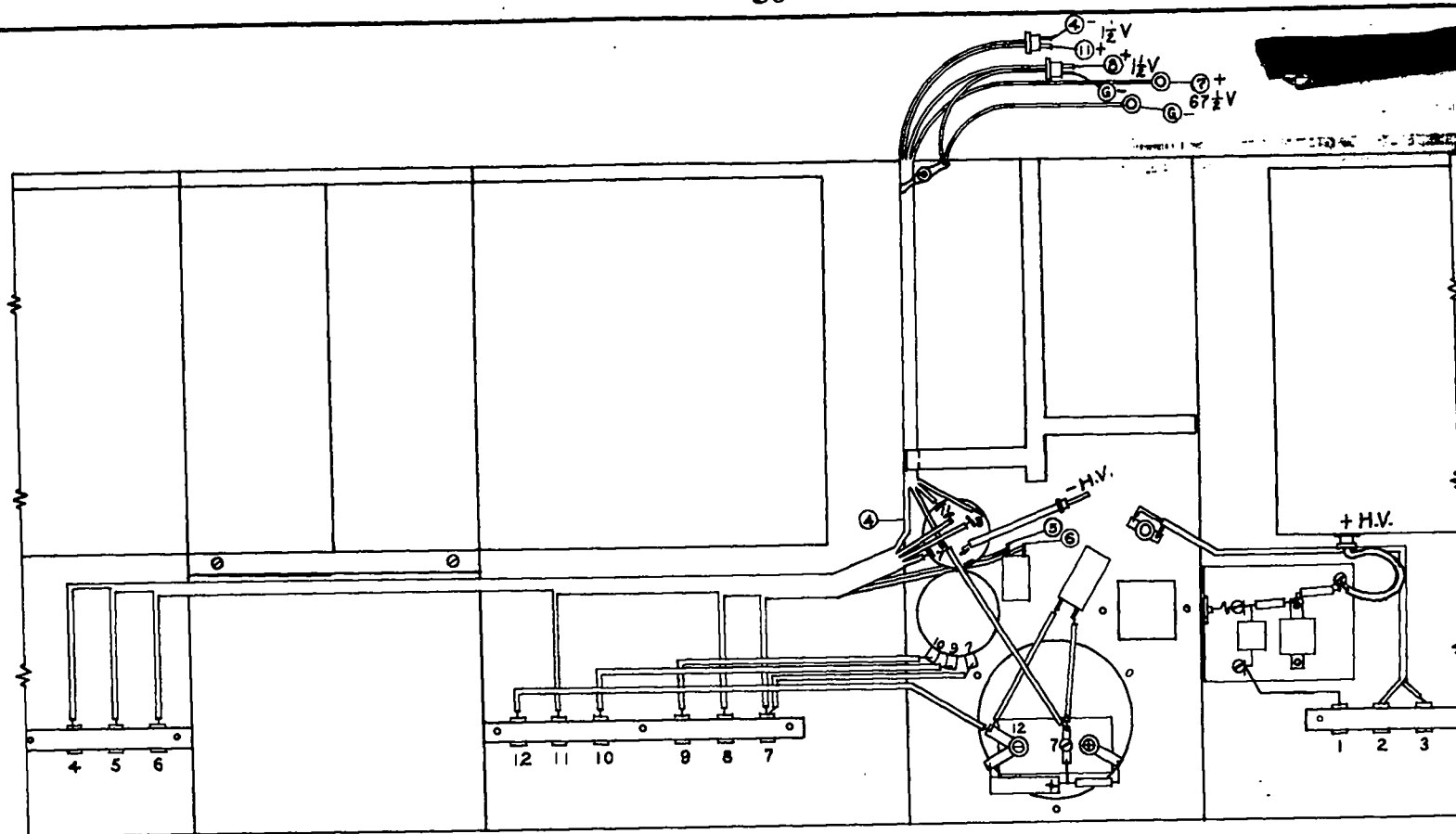
FULL SIZE



CMR-12
INSTRUMENT SECTION

DRAWN BY: J.L.	APPROVED: H.C.
DATE: MAY 3, 1948	SCALE - $\frac{1}{2}'' = 1'$
DRAWG. NO. 4	

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LEFT SIDE

BOTTOM

RIGHT SIDE

TOP

LEFT SIDE

BOX WIRING

CMR-12
INSTRUMENT SECTION

DRAWN BY: [REDACTED] APPROVED: HCB
DATE: APR. 29, 1948 SCALE: 1/2" = 1"
DRWG. NO. 5

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